

Figure 1

09/913778

Publication	PECVD Reaction	Doping Control Method	Post-die Thermal Anneal Temp (°C)
Valette S., 1987	Unknown	P doping	Not specified
Valette S., 1988	Unknown	P doping	400°C
Grand G., 1990	Unknown	P doping	1000°C
Liu K., 1995	Unknown	Content in Si, P	Not specified
Ojha S., 1998	Unknown	Ge, B, or P doping	Not specified
Canning J., 1998	Unknown	Ge doping	Not specified
Bulla D., 1998	TEOS	TEOS	Not specified
Johnson C., 1998	$\text{SiH}_4 + \text{O}_2$	Si ion Implantation	400°C
Boswell R. W., 1997	$\text{SiH}_4 + \text{O}_2$	SiH_4/O_2 flow ratio	1000°C
Bazylenko M. V., 1995	$\text{SiH}_4 + \text{O}_2 + \text{CF}_4$	$(\text{SiH}_4 + \text{O}_2)/\text{CF}_4$ flow ratio	Not specified
Bazylenko M. V., 1996	$\text{SiH}_4 + \text{O}_2 + \text{CF}_4$	$(\text{SiH}_4 + \text{O}_2)/\text{CF}_4$ flow ratio	1000°C
Durand A., 1996	$\text{SiH}_4 + \text{O}_2 + \text{CF}_4$	$\text{SiH}_4/\text{O}_2/\text{CF}_4$ flow ratio	100°C
Kapser K., 1991	$\text{SiH}_4 + \text{N}_2\text{O}$	$\text{SiH}_4/\text{N}_2\text{O}$ flow ratio	1060°C
Lai Q., 1992	$\text{SiH}_4 + \text{N}_2\text{O}$	$\text{SiH}_4/\text{N}_2\text{O}$ flow ratio	1100°C
Lai Q., 1993	$\text{SiH}_4 + \text{N}_2\text{O}$	$\text{SiH}_4/\text{N}_2\text{O}$ flow ratio	1100°C
Pereyra I., 1997	$\text{SiH}_4 + \text{N}_2\text{O}$	$\text{SiH}_4/\text{N}_2\text{O}$ flow ratio	400°C
Alayo M., 1998	$\text{SiH}_4 + \text{N}_2\text{O}$	$\text{SiH}_4/\text{N}_2\text{O}$ flow ratio	1000°C
Kenyon T., 1997	$\text{SiH}_4 + \text{N}_2\text{O} + \text{Ar}$	$\text{SiH}_4/\text{N}_2\text{O}/\text{Ar}$ flow ratio	1000°C
Lam D. K. W., 1984	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3$ flow ratio	Not specified
Bruno F., 1991	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3$ flow ratio	1100°C
Yokohama S., 1995	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3$ flow ratio	Not specified
Agnihotri O. P., 1997	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3$ flow ratio	700-900°C
Germann R., 1999	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	Unknown	1100°C
Offrein B., 1999	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3$	Unknown	1150°C
Hoffmann M., 1995	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{Ar}$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3/\text{Ar}$ flow ratio	Not specified
Hoffmann M., 1997	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{Ar}$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3/\text{Ar}$ flow ratio	Not specified
Tu Y., 1995	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{N}_2$	$\text{N}_2\text{O}/(\text{N}_2\text{O} + \text{NH}_3)$ flow ratio	1050°C
Poenar D., 1997	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{N}_2$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3/\text{N}_2$ flow ratio	850°C
Ridder R., 1998	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{N}_2$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3/\text{Ar}$ flow ratio	1100°C
Worhoff K., 1999	$\text{SiH}_4 + \text{N}_2\text{O} + \text{NH}_3 + \text{N}_2$	$\text{SiH}_4/\text{N}_2\text{O}/\text{NH}_3/\text{N}_2$ flow ratio	1150°C
Bulat E.S., 1993	$\text{SiH}_4 + \text{N}_2\text{O} + \text{N}_2 + \text{O}_2 + \text{He} + \text{CF}_4$	$\text{SiH}_4/(\text{N}_2\text{O}/\text{N}_2)/\text{O}_2/\text{CF}_4$ flow ratio	425°C
This Patent Application	$\text{SiH}_4 + \text{N}_2\text{O} + \text{PH}_3 + \text{N}_2$	Patented Pending Method	650°C

Figure 2

Figure 2 shows the FTIR spectra of the samples. The x-axis represents the wavenumber in cm⁻¹, ranging from 4000 to 400. The y-axis represents the transmittance. The spectra show characteristic peaks for the samples, including the broad O-H stretching band around 3400 cm⁻¹, the sharp C-H stretching bands around 2900 cm⁻¹, and the strong C=O stretching band around 1700 cm⁻¹. The spectra are labeled with the sample names: HO-H, SiO-H, SiN-H, SiN-H, Si-H, Si=O, N=N, Si-O-Si, Si-O-Si, Si-OH, Si-O-Si, and Si-O-Si.

		HO-H	SiO-H	SiN-H	SiN-H	Si-H	Si=O	N=N	Si-O-Si	Si-O-Si	Si-OH	Si-O-Si	Si-O-Si
FTIR	1st mode (cm⁻¹)	Min	3550	3470	3380	3300	2210	1800	1530	1080	1000	910	860
		Ave	3650	3510	3420	3380	2260	1875	1555	1180	1080	950	885
		Max	3750	3550	3460	3460	2310	1950	1580	1280	1160	990	910
1st mode (μm)	Min	2.817	2.882	2.959	3.030	4.525	5.556	6.536	9.259	10.000	10.989	11.628	13.514
	Ave	2.740	2.849	2.924	2.959	4.425	5.333	6.431	8.475	9.259	10.526	11.299	12.346
	Max	2.667	2.817	2.890	2.890	4.329	5.128	6.329	7.813	8.621	10.101	10.989	11.364
2nd mode (μm)	Min	1.408	1.441	1.479	1.515	2.262	2.778	3.268	4.630	5.000	5.495	5.814	6.757
	Ave	1.370	1.425	1.462	1.479	2.212	2.667	3.215	4.237	4.630	5.263	5.650	6.173
	Max	1.333	1.408	1.445	1.445	2.165	2.564	3.165	3.906	4.310	5.051	5.495	5.682
3rd mode (μm)	Min	0.939	0.961	0.986	1.010	1.508	1.852	2.179	3.086	3.333	3.663	3.876	4.505
	Ave	0.913	0.950	0.975	0.986	1.475	1.778	2.144	2.825	3.086	3.509	3.766	4.115
	Max	0.889	0.939	0.963	0.963	1.443	1.709	2.110	2.604	2.874	3.367	3.663	3.788
4th mode (μm)	Min	0.704	0.720	0.740	0.758	1.131	1.389	1.634	2.315	2.500	2.747	2.907	3.378
	Ave	0.685	0.712	0.731	0.740	1.106	1.333	1.608	2.119	2.315	2.632	2.825	3.086
	Max	0.667	0.704	0.723	0.723	1.082	1.282	1.582	1.953	2.155	2.525	2.747	2.841
5th mode (μm)	Min	0.563	0.576	0.592	0.606	0.905	1.111	1.307	1.852	2.000	2.198	2.326	2.703
	Ave	0.548	0.570	0.585	0.592	0.885	1.067	1.286	1.695	1.852	2.105	2.260	2.469
	Max	0.533	0.563	0.578	0.578	0.866	1.026	1.266	1.563	1.724	2.020	2.198	2.273
6th mode (μm)	Min	0.469	0.480	0.493	0.505	0.754	0.926	1.089	1.543	1.667	1.832	1.938	2.252
	Ave	0.457	0.475	0.487	0.493	0.737	0.889	1.072	1.412	1.543	1.754	1.883	2.058
	Max	0.444	0.469	0.482	0.482	0.722	0.855	1.055	1.302	1.437	1.684	1.832	1.894
7th mode (μm)	Min	0.402	0.412	0.423	0.433	0.646	0.794	0.934	1.323	1.429	1.570	1.661	1.931
	Ave	0.391	0.407	0.418	0.423	0.632	0.762	0.919	1.211	1.323	1.504	1.614	1.764
	Max	0.381	0.402	0.413	0.413	0.618	0.733	0.904	1.116	1.232	1.443	1.570	1.623
8th mode (μm)	Min	0.352	0.360	0.370	0.379	0.566	0.694	0.817	1.157	1.250	1.374	1.453	1.689
	Ave	0.342	0.356	0.365	0.370	0.553	0.667	0.804	1.059	1.157	1.316	1.412	1.543
	Max	0.333	0.352	0.361	0.361	0.541	0.641	0.791	0.977	1.078	1.263	1.374	1.420

Figure 3a

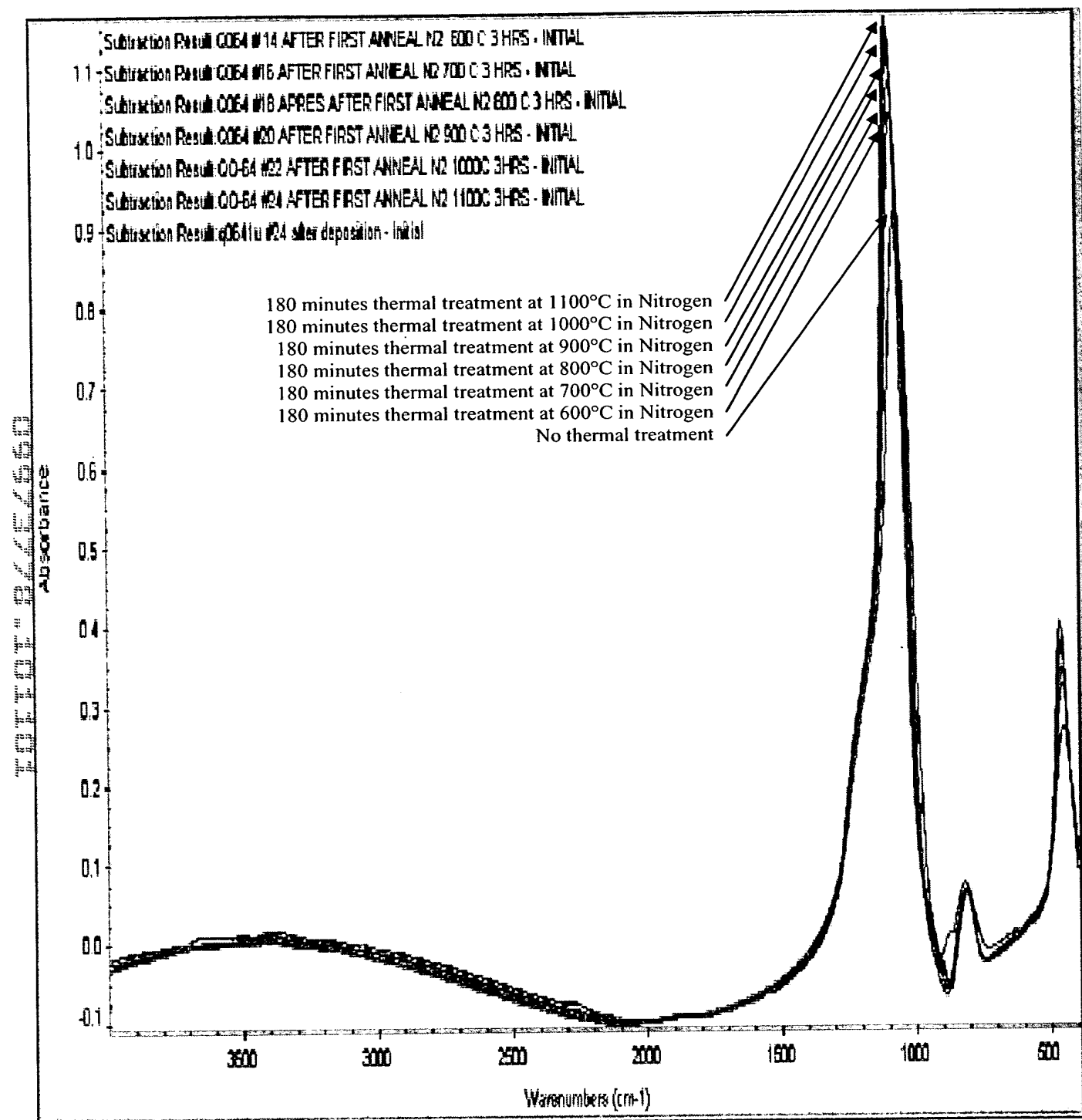


Figure 3b

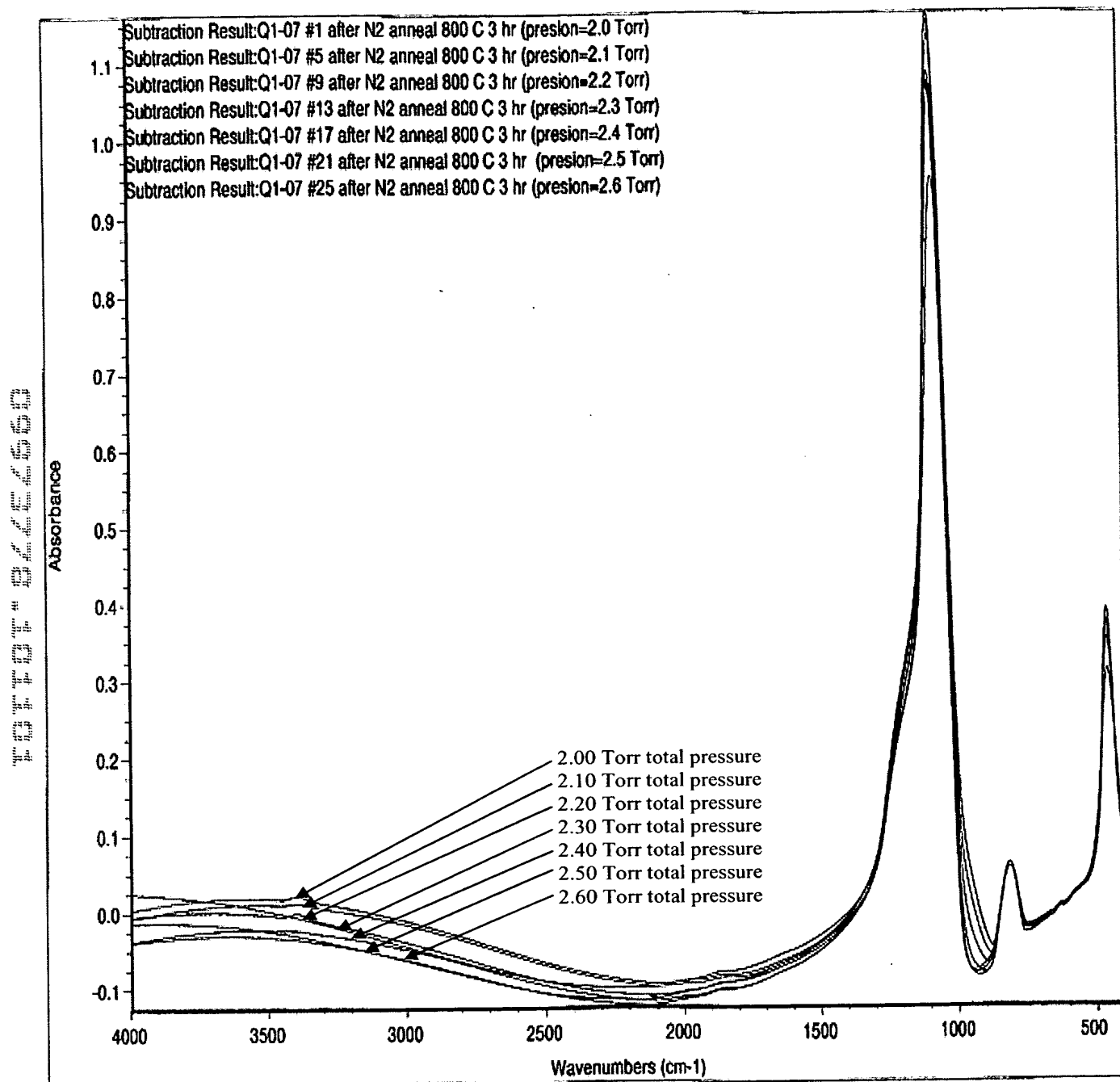


Figure 3c

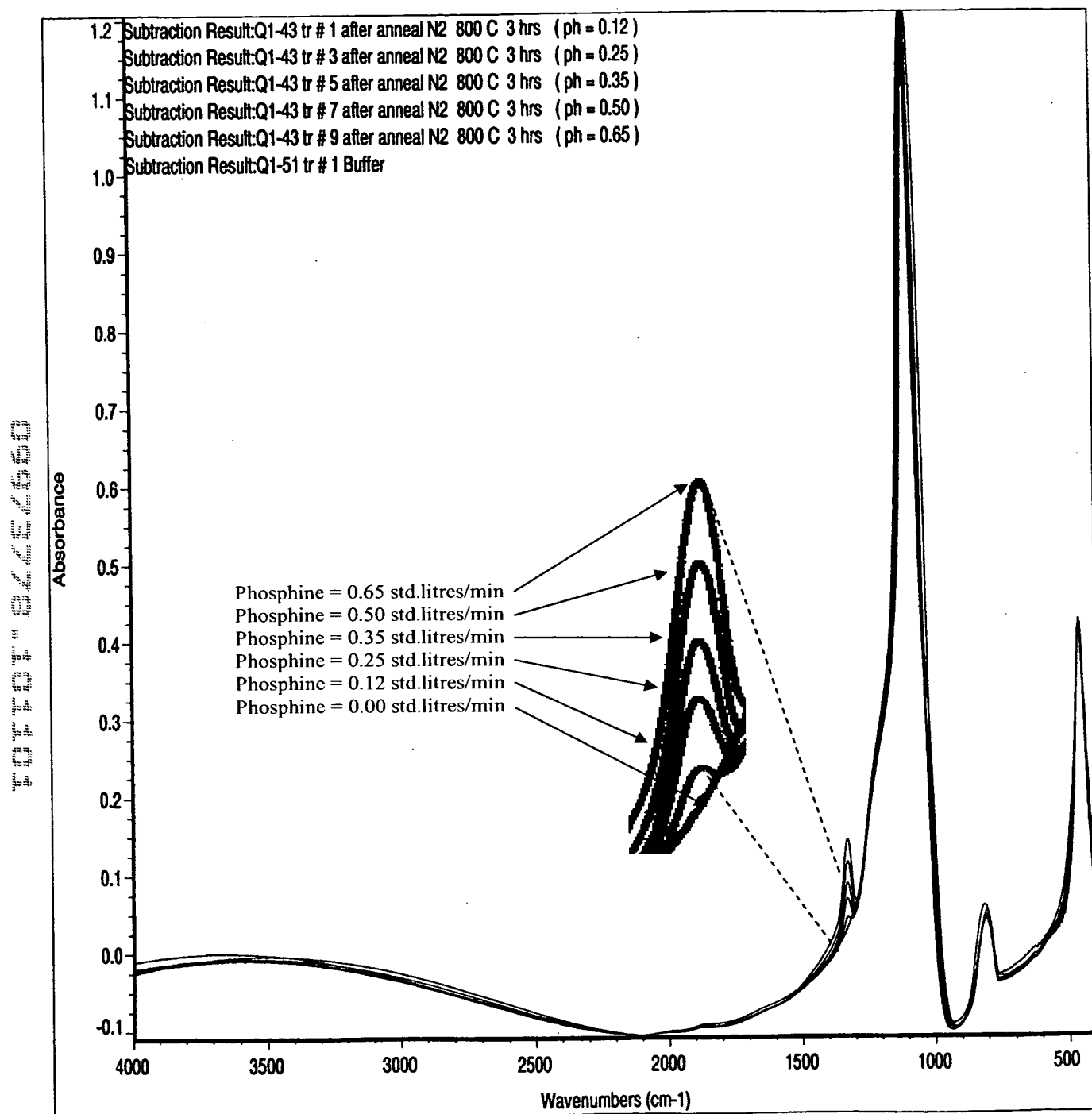


Figure 3d

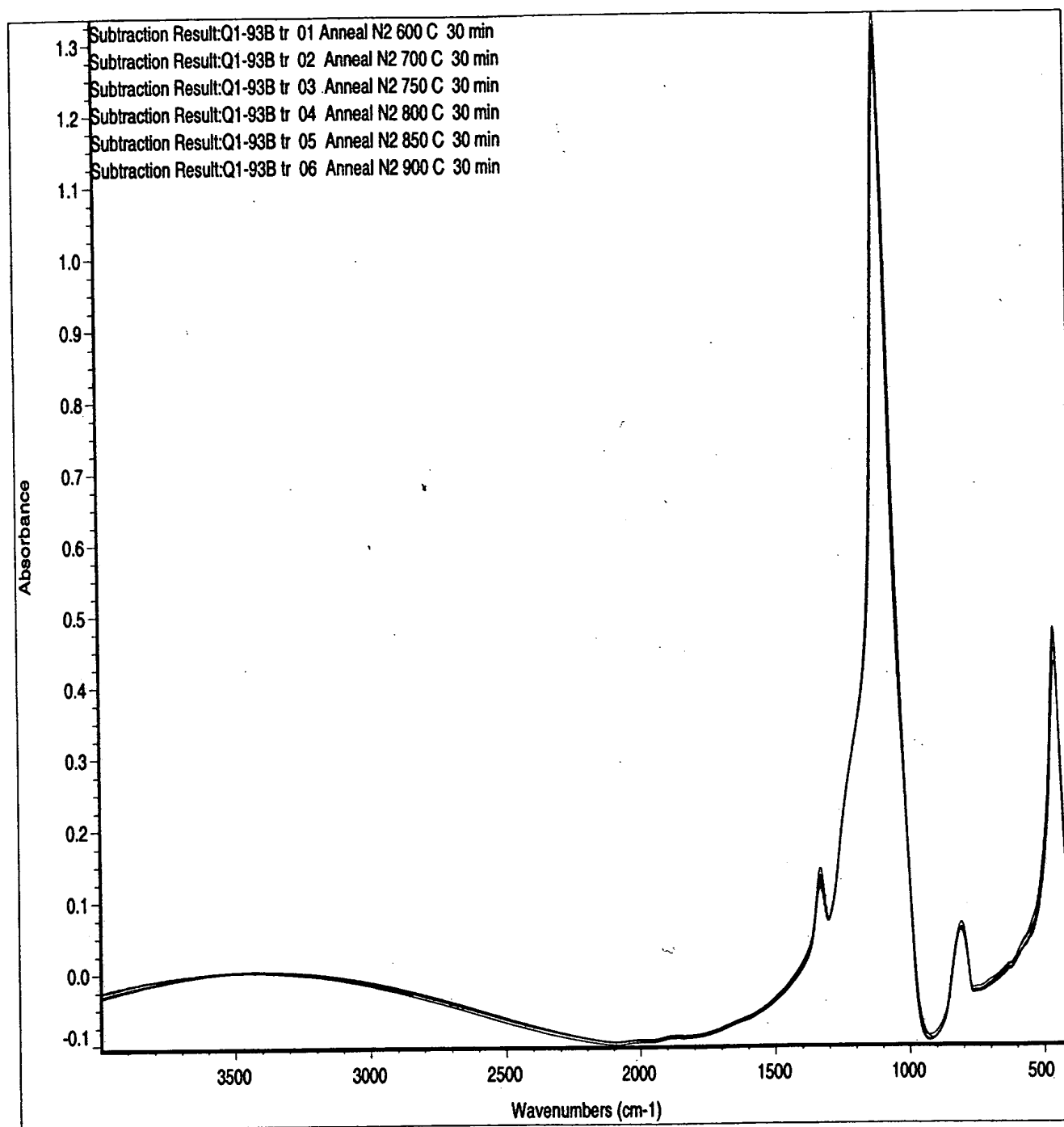


Figure 4a

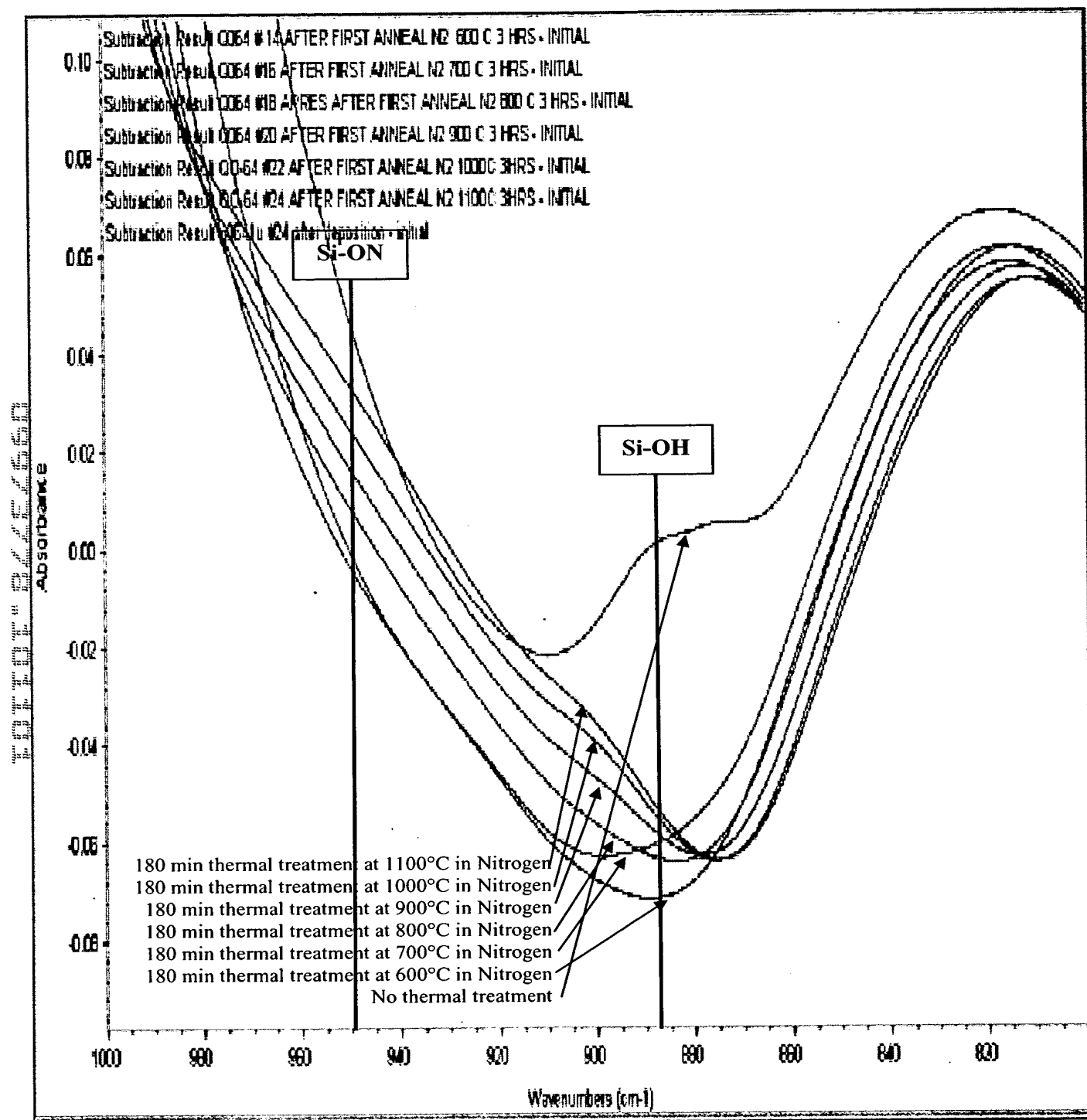


Figure 4b

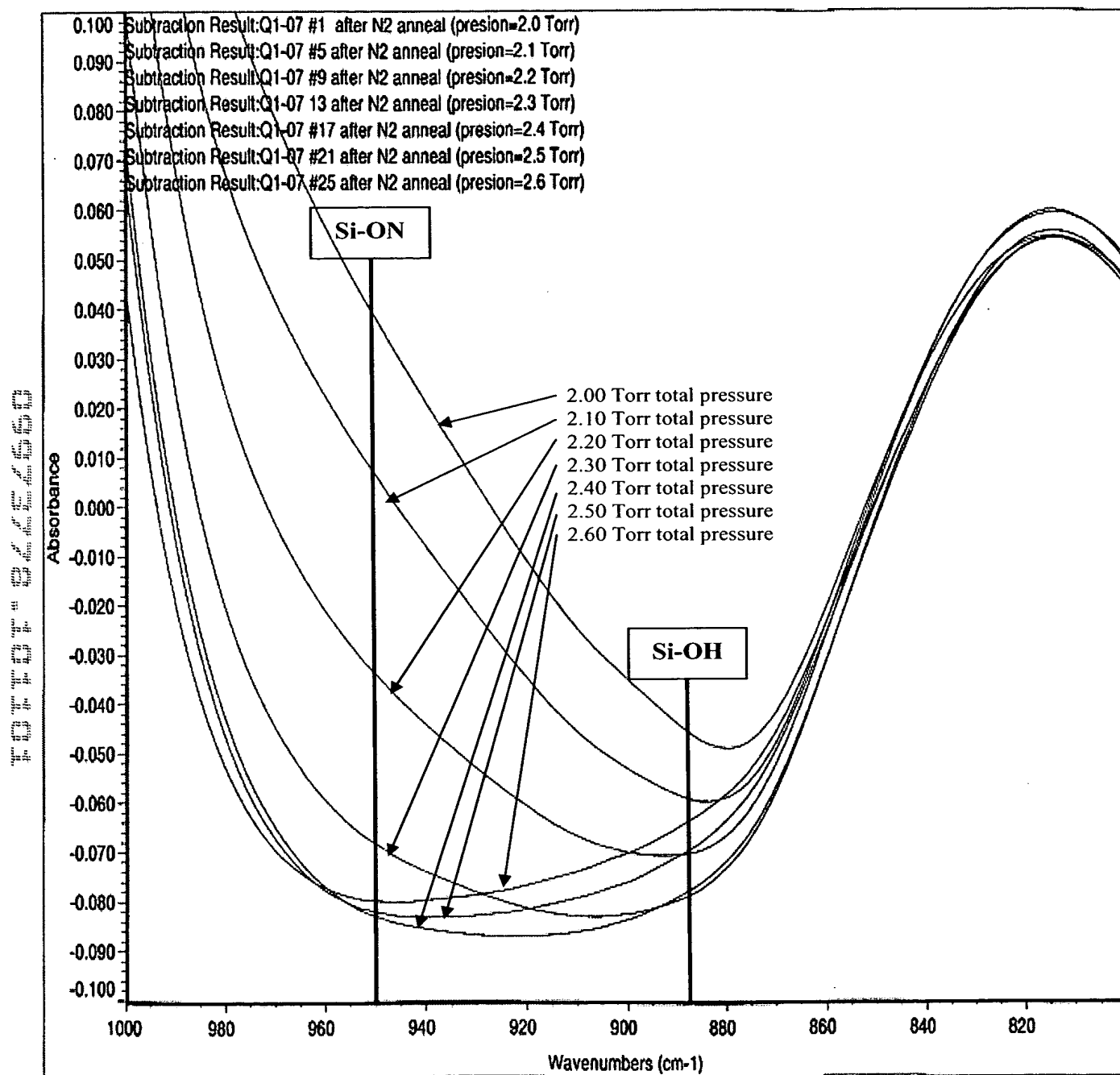


Figure 4c

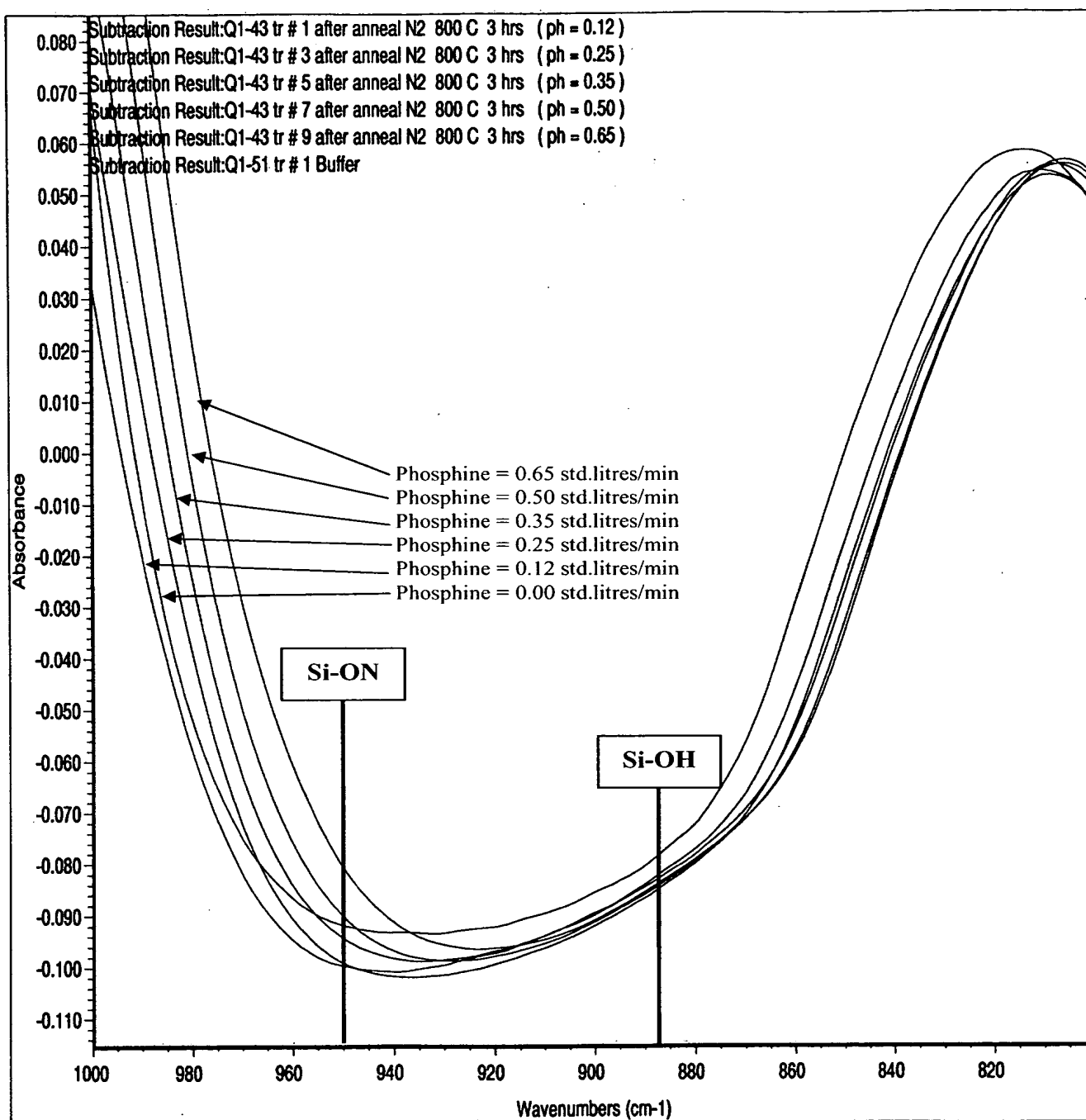


Figure 4d

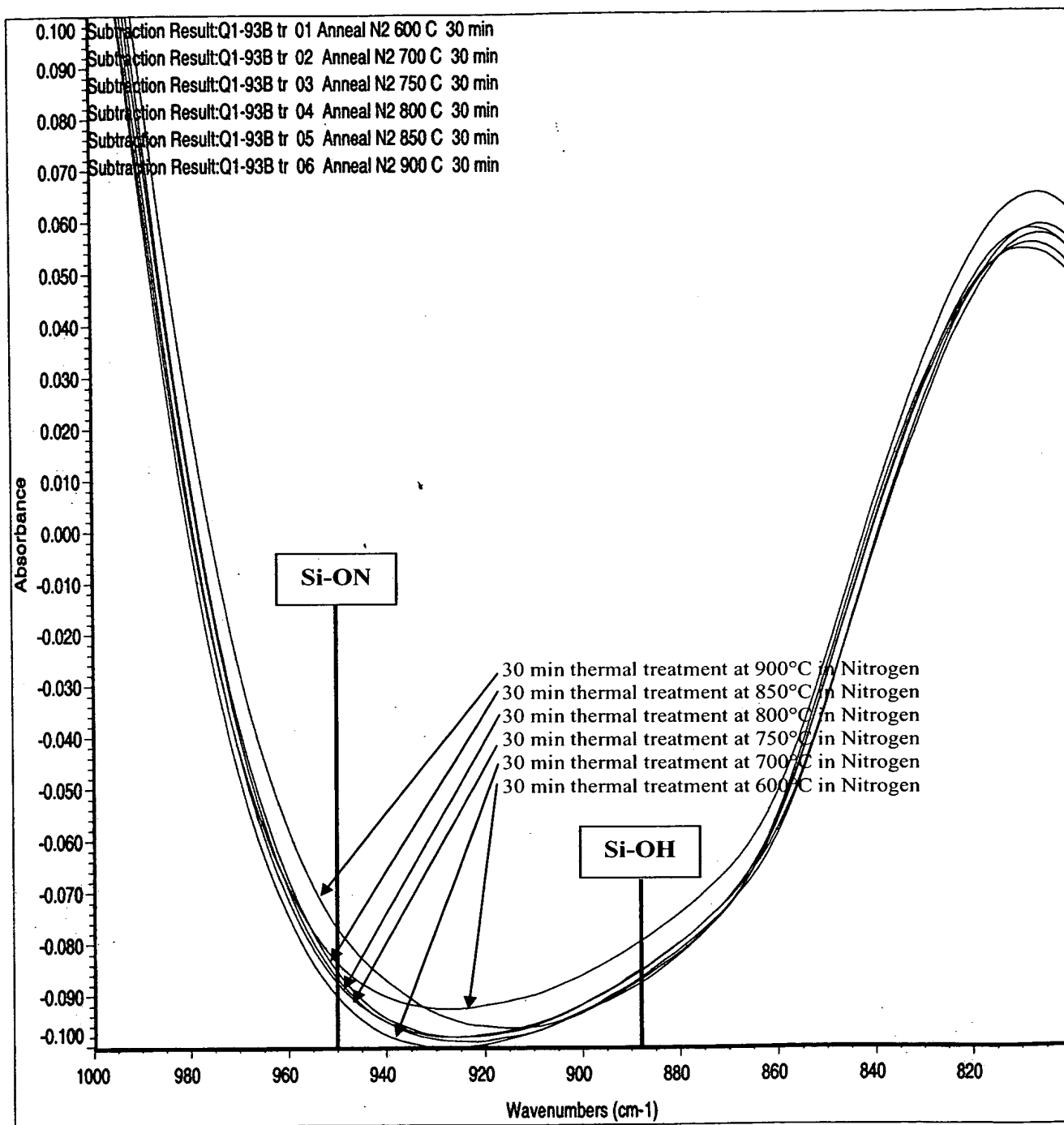


Figure 5c

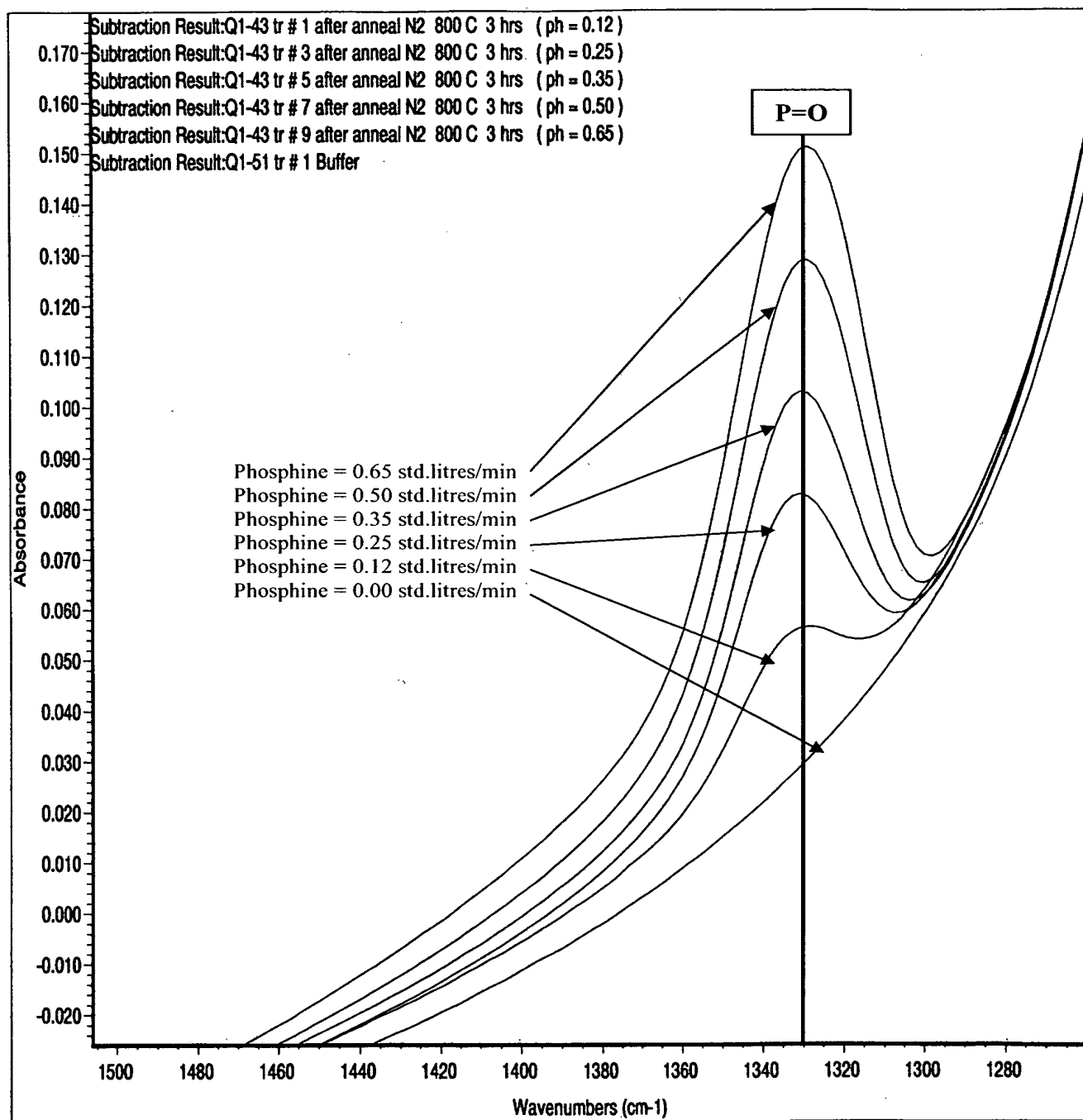


Figure 5d

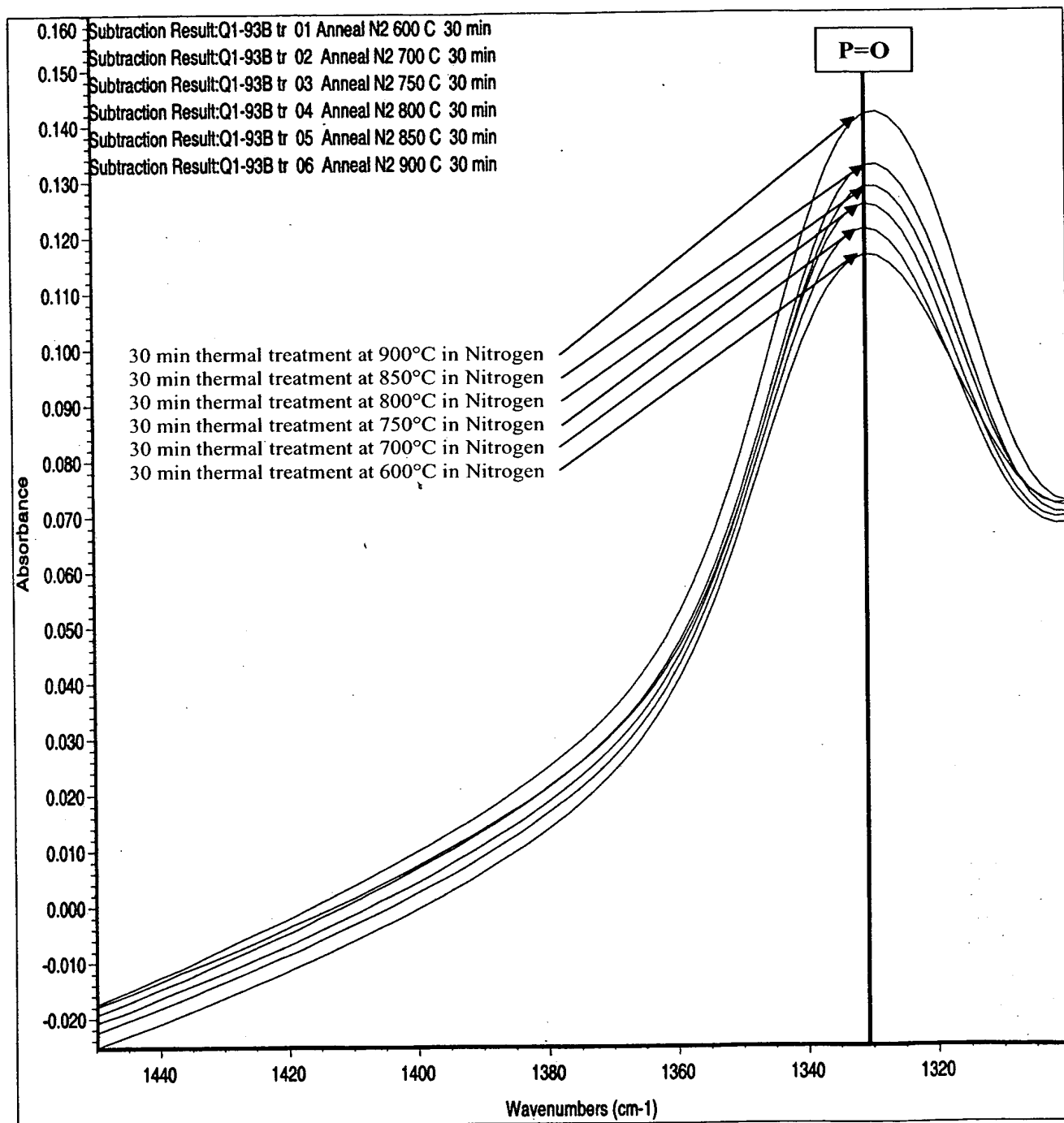


Figure 6a

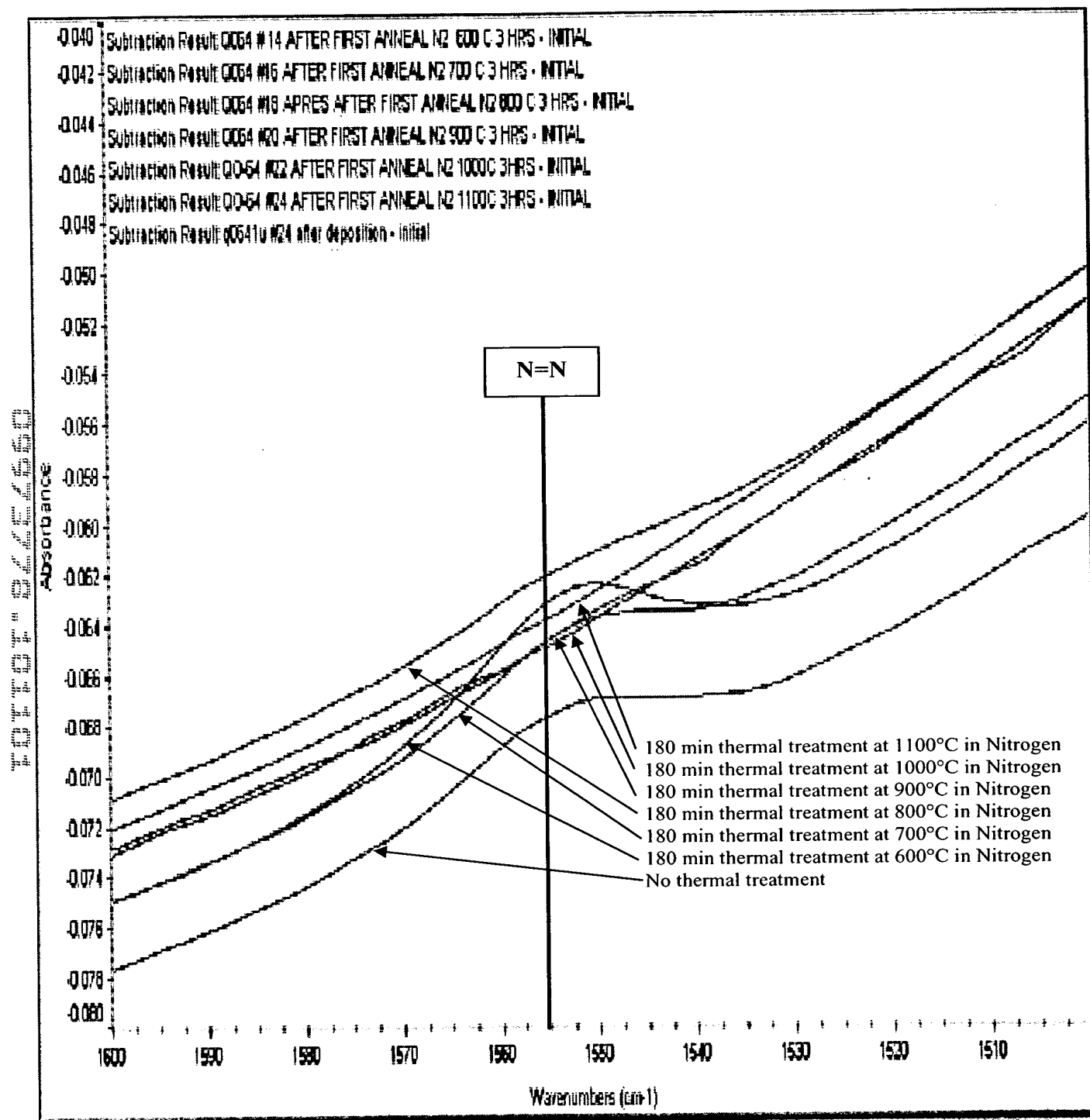


Figure 6b

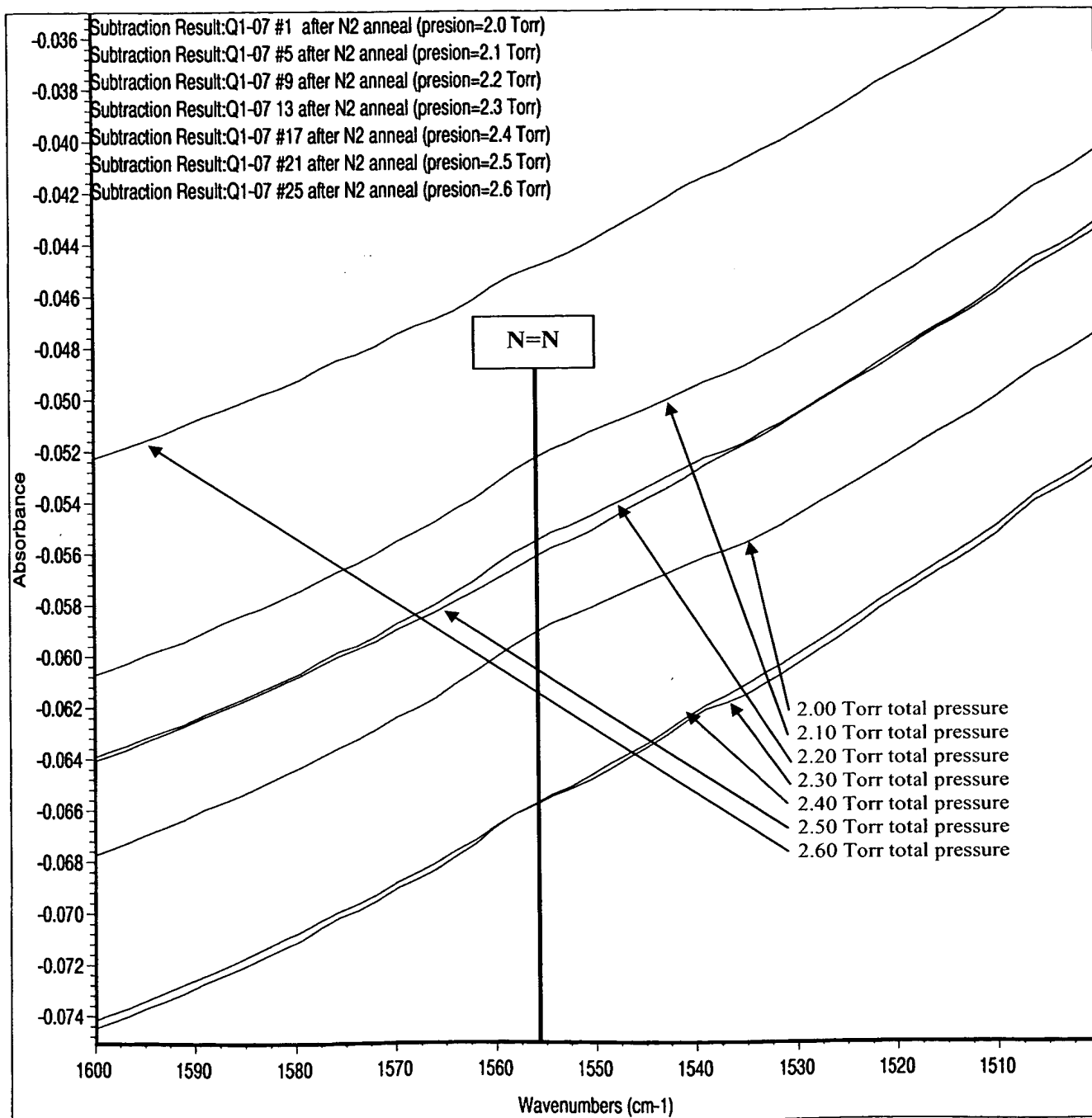


Figure 6c

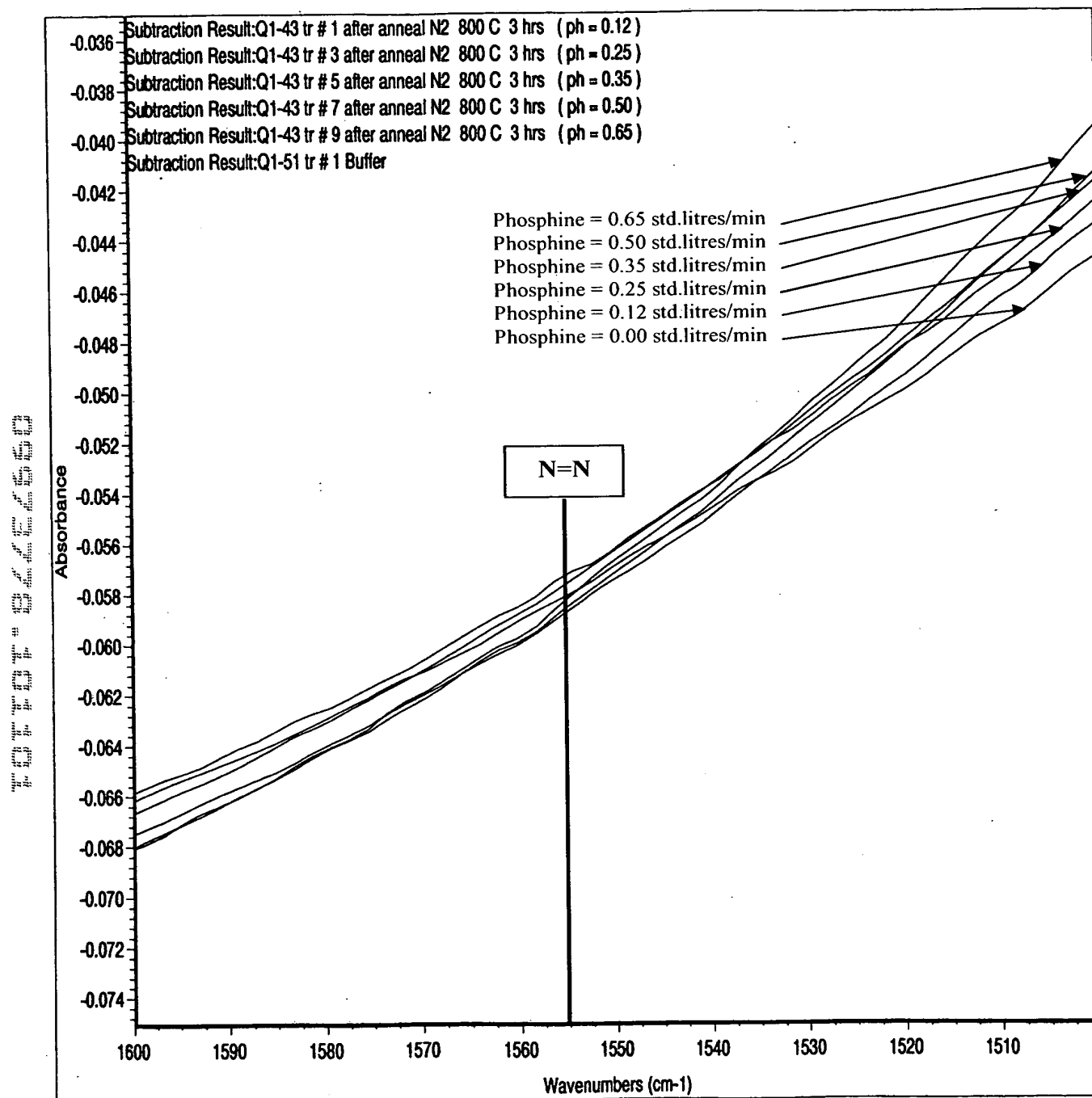


Figure 6d

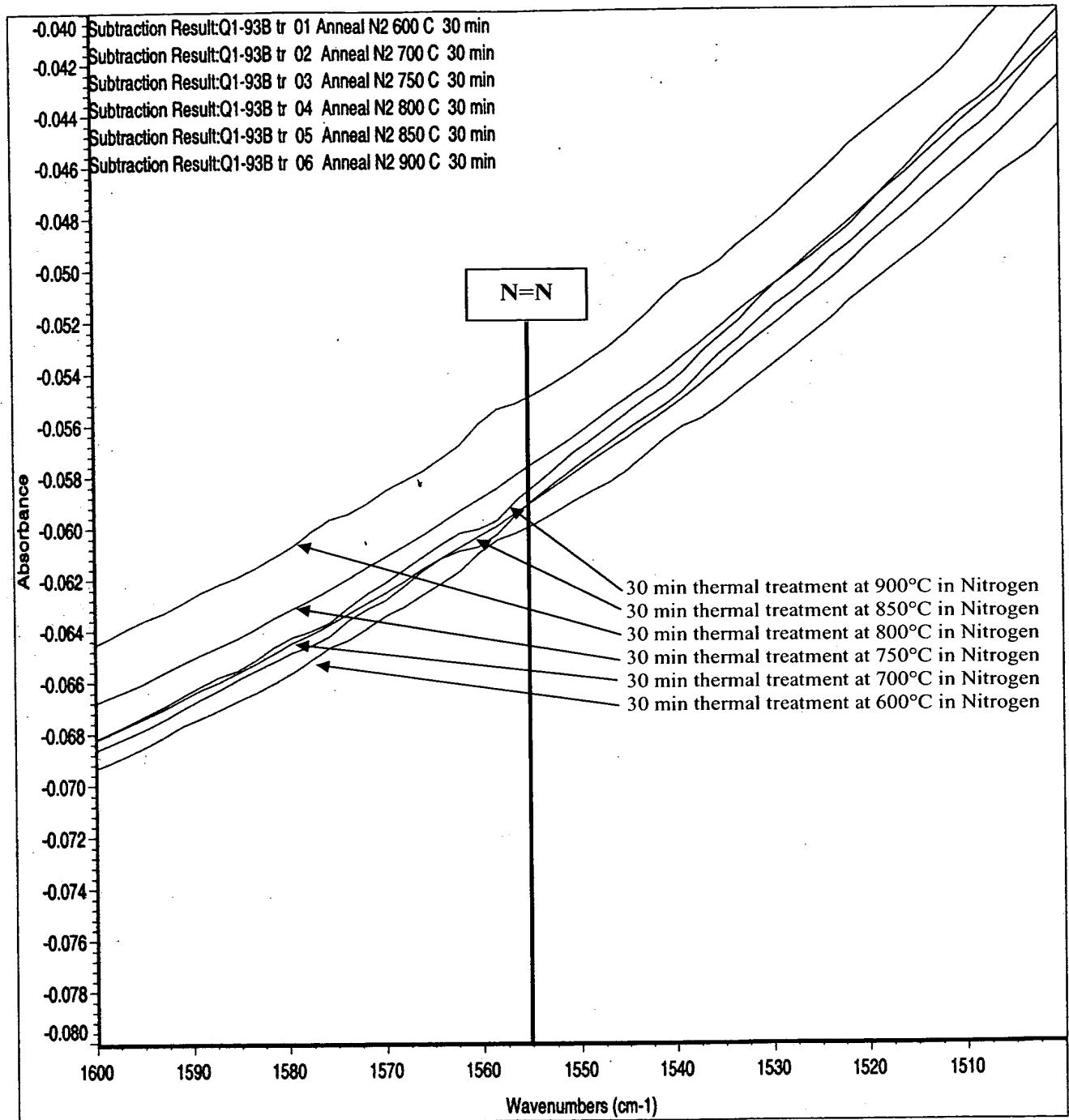


Figure 7a

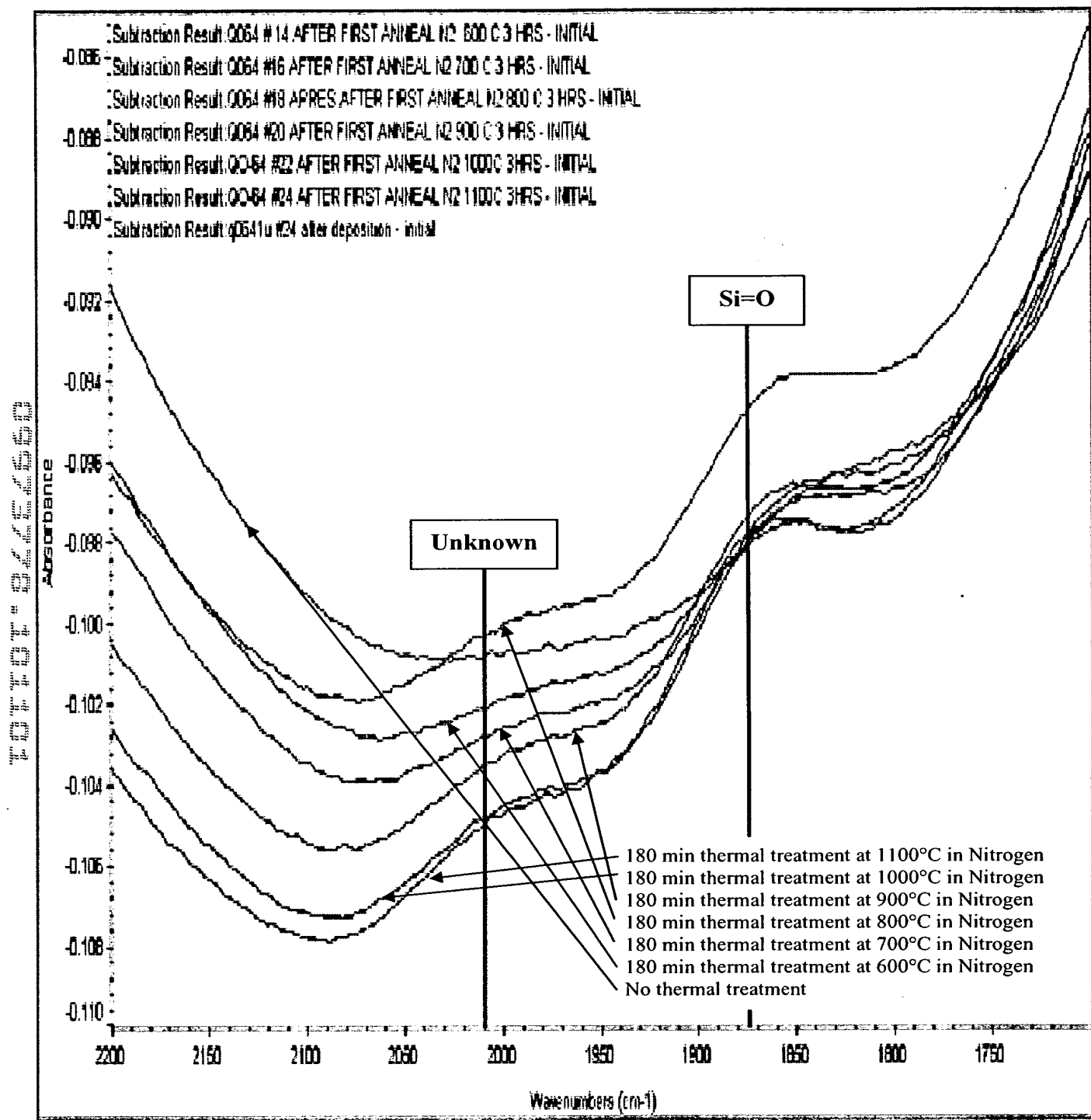


Figure 7b

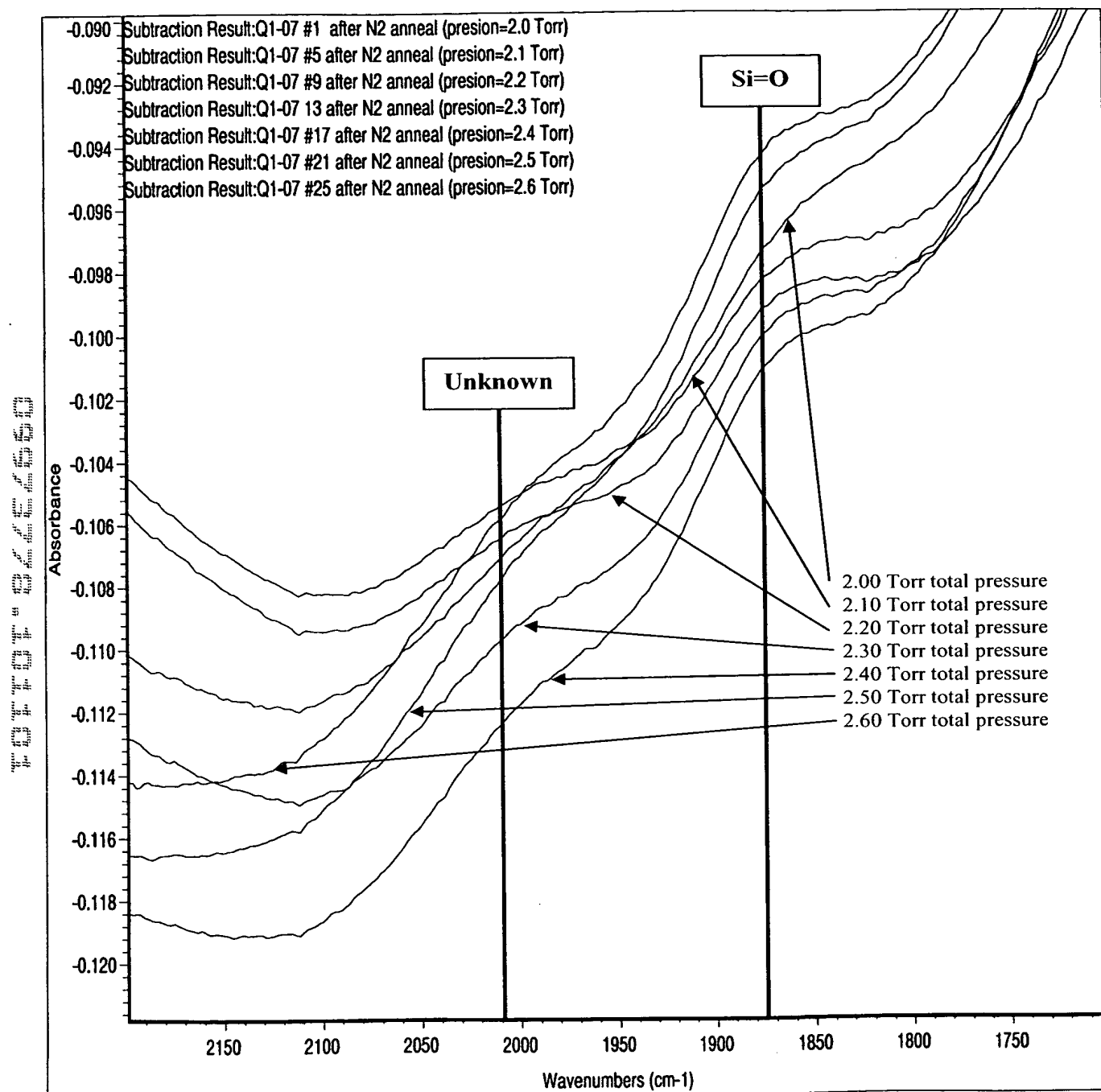


Figure 7c

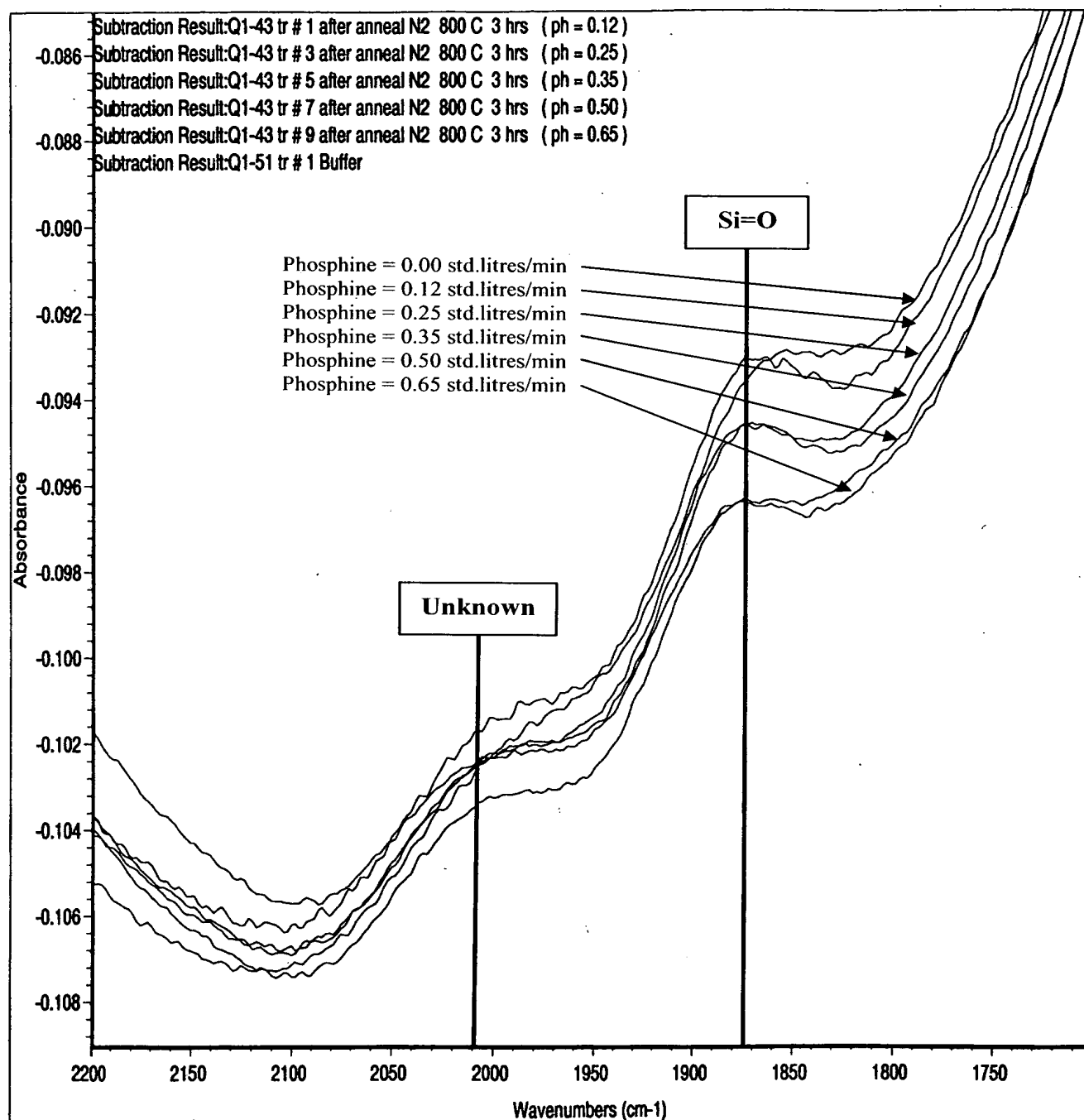


Figure 7d

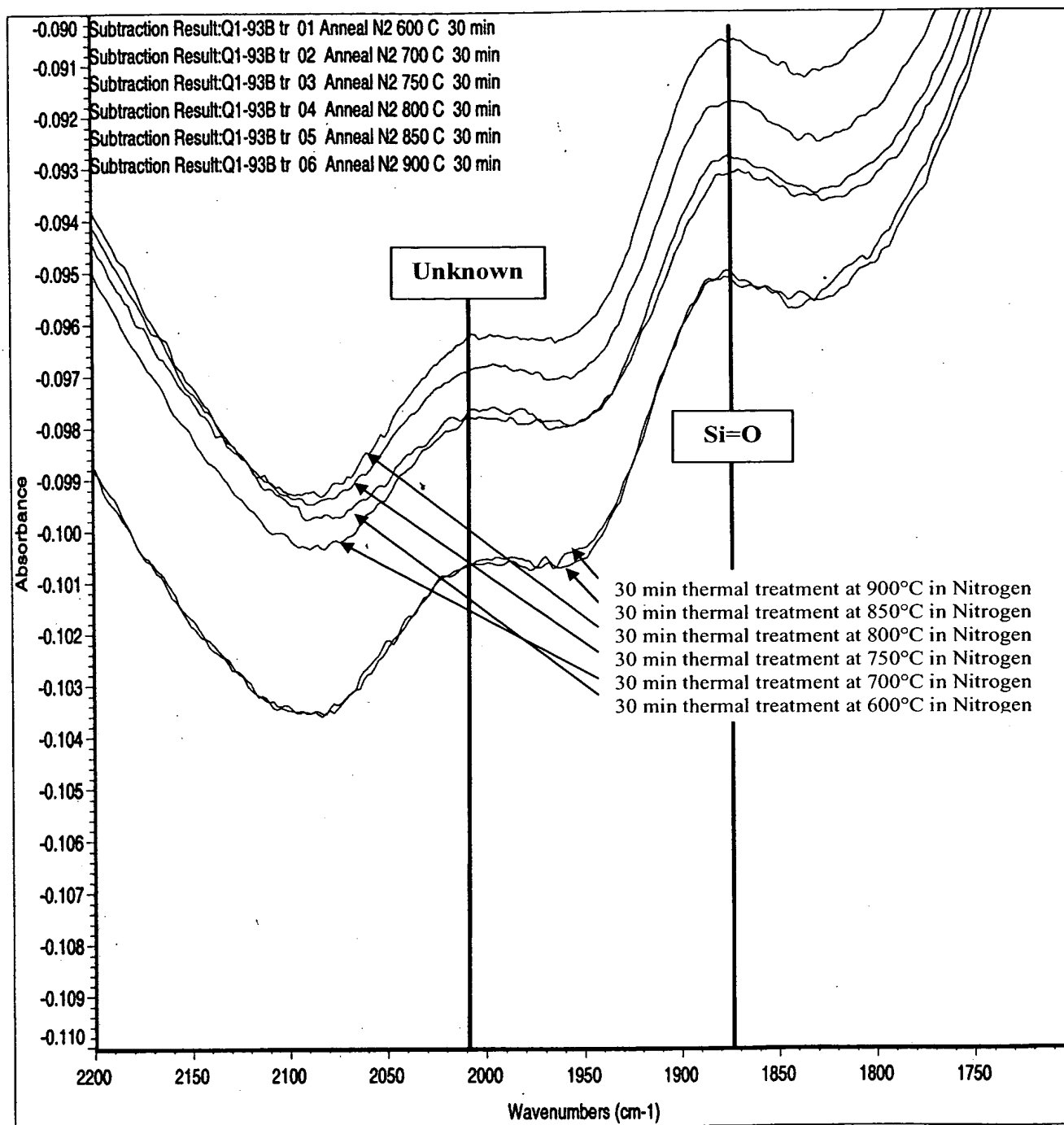


Figure 8a

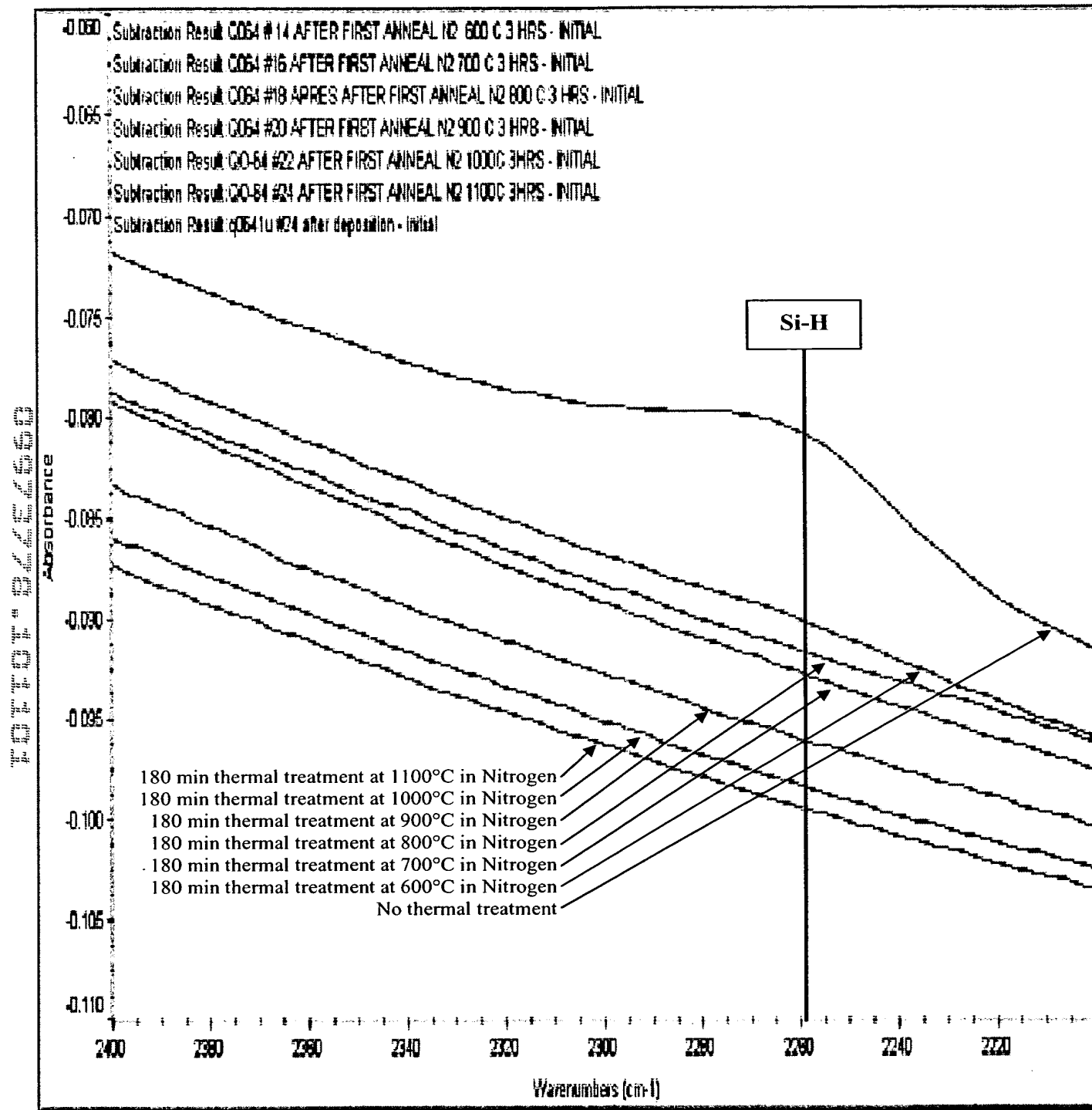


Figure 8b

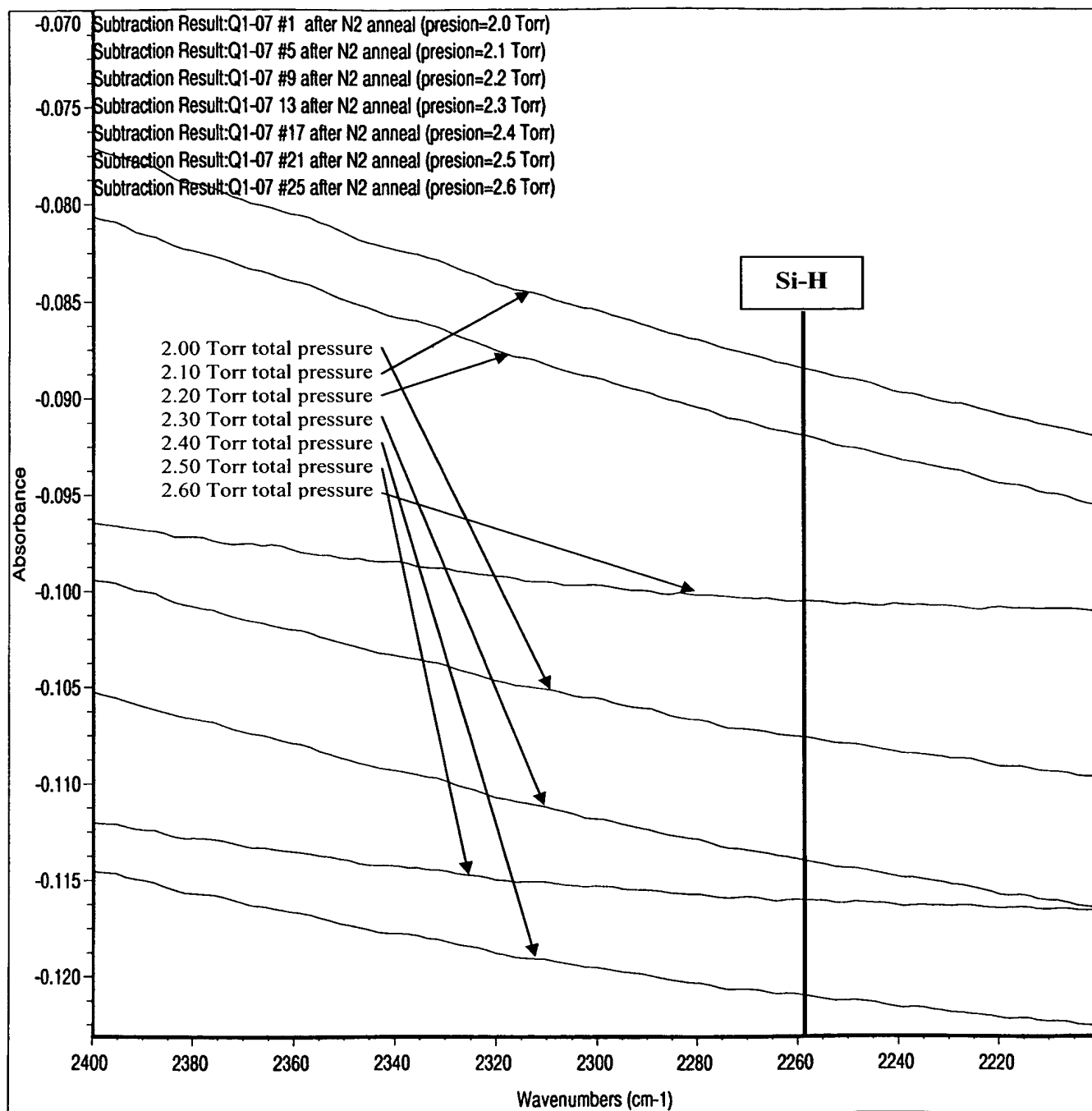


Figure 8c

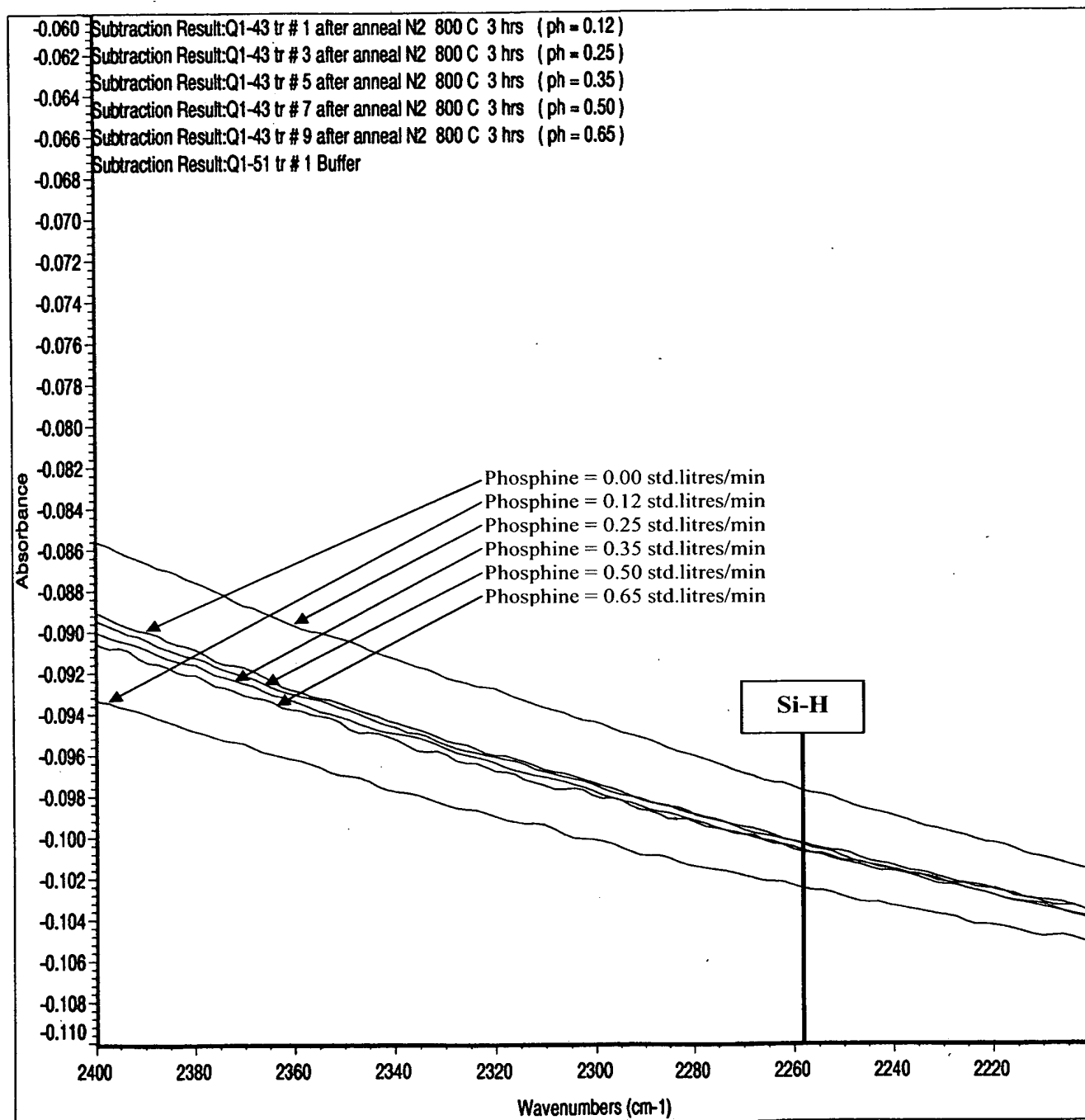


Figure 8d

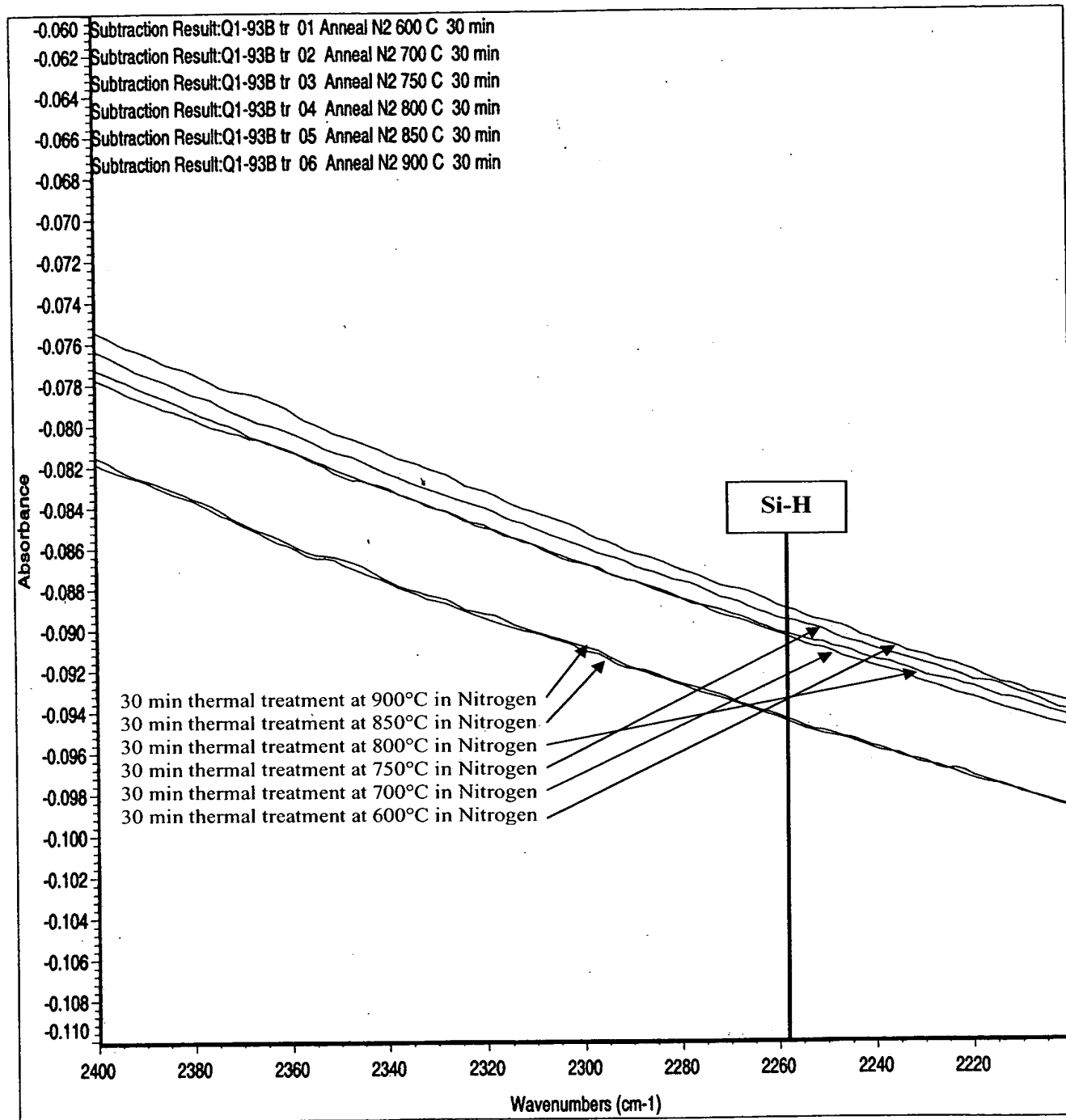


Figure 9a

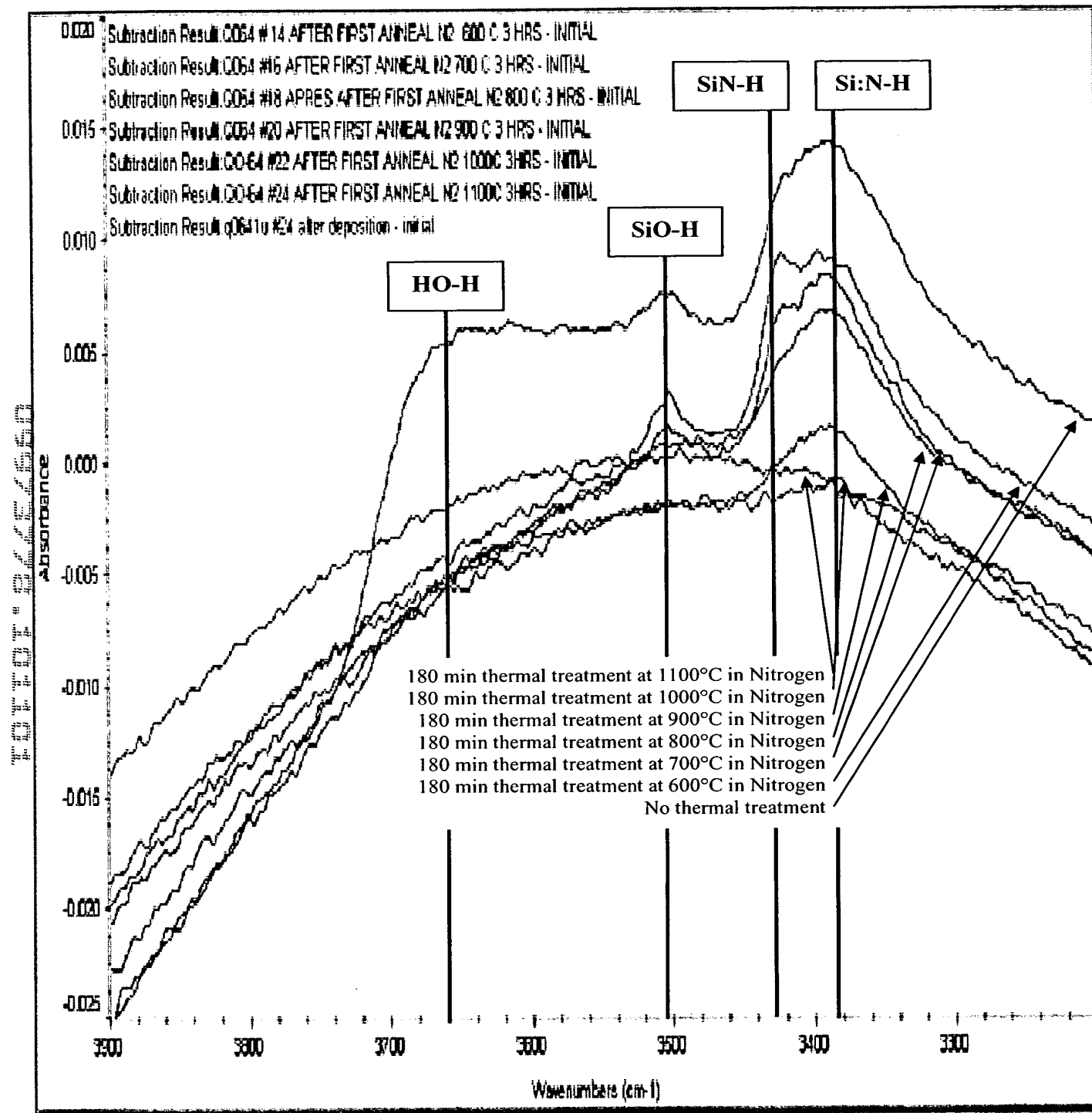


Figure 9b

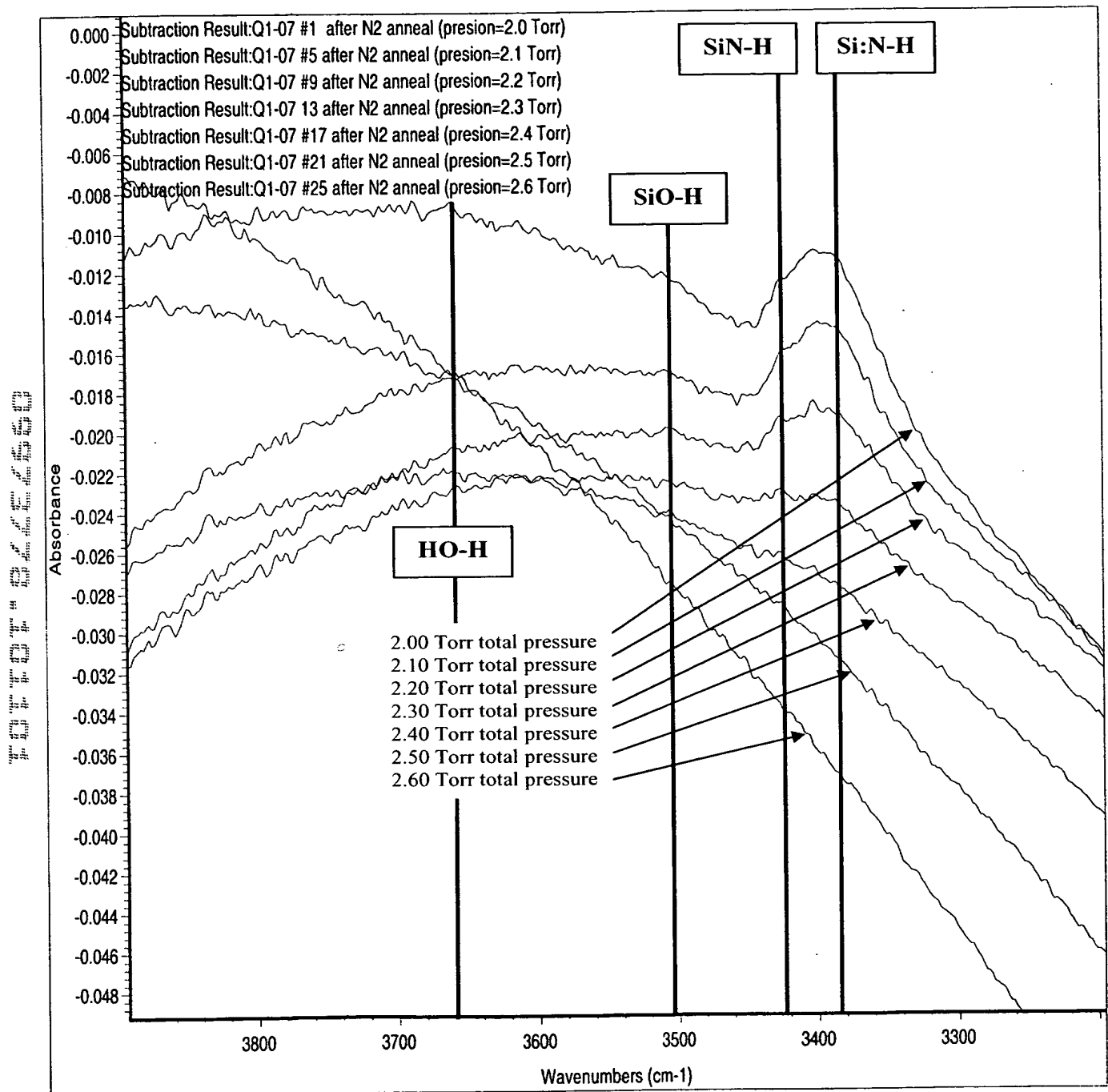


Figure 9c

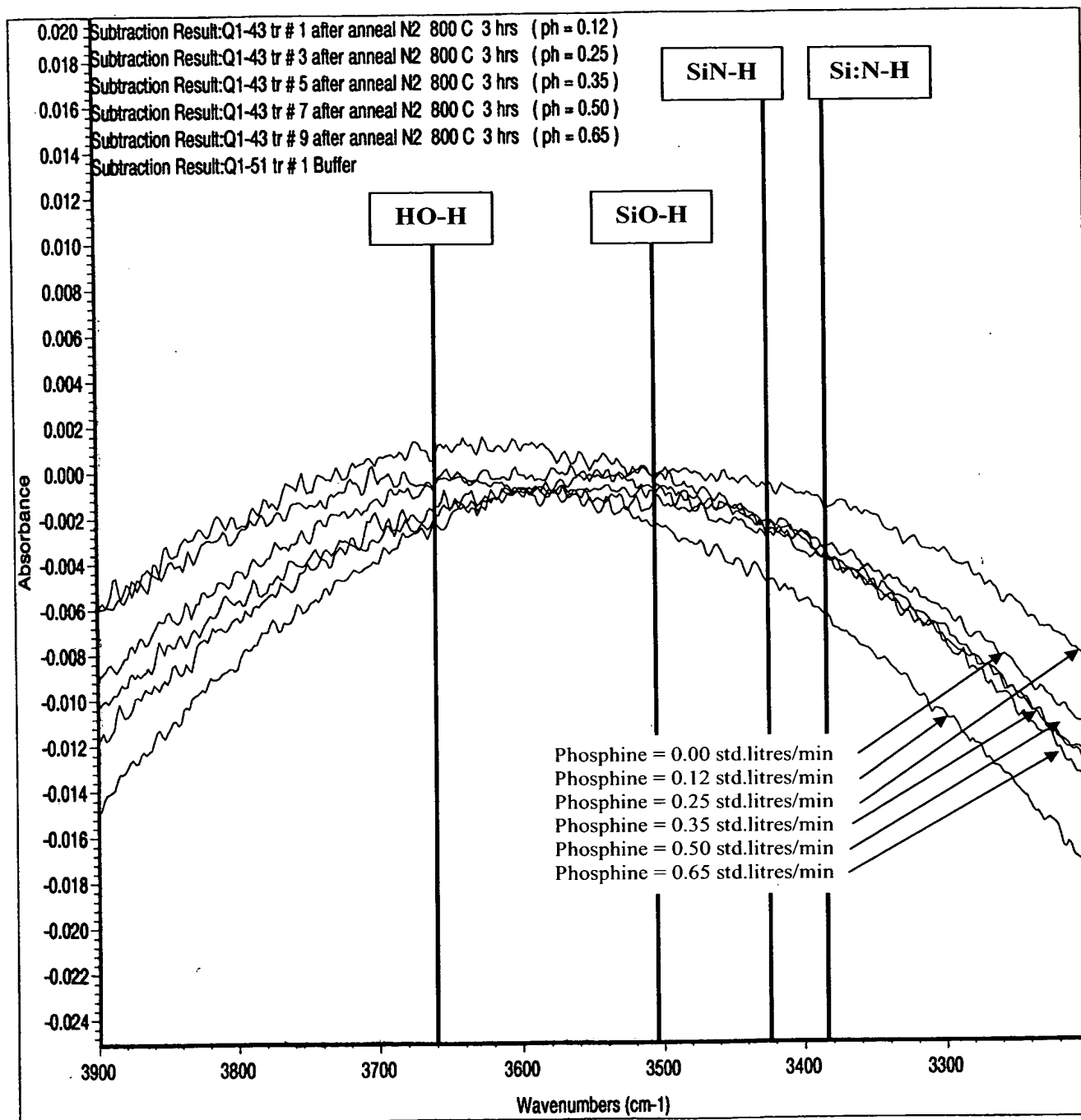


Figure 9d

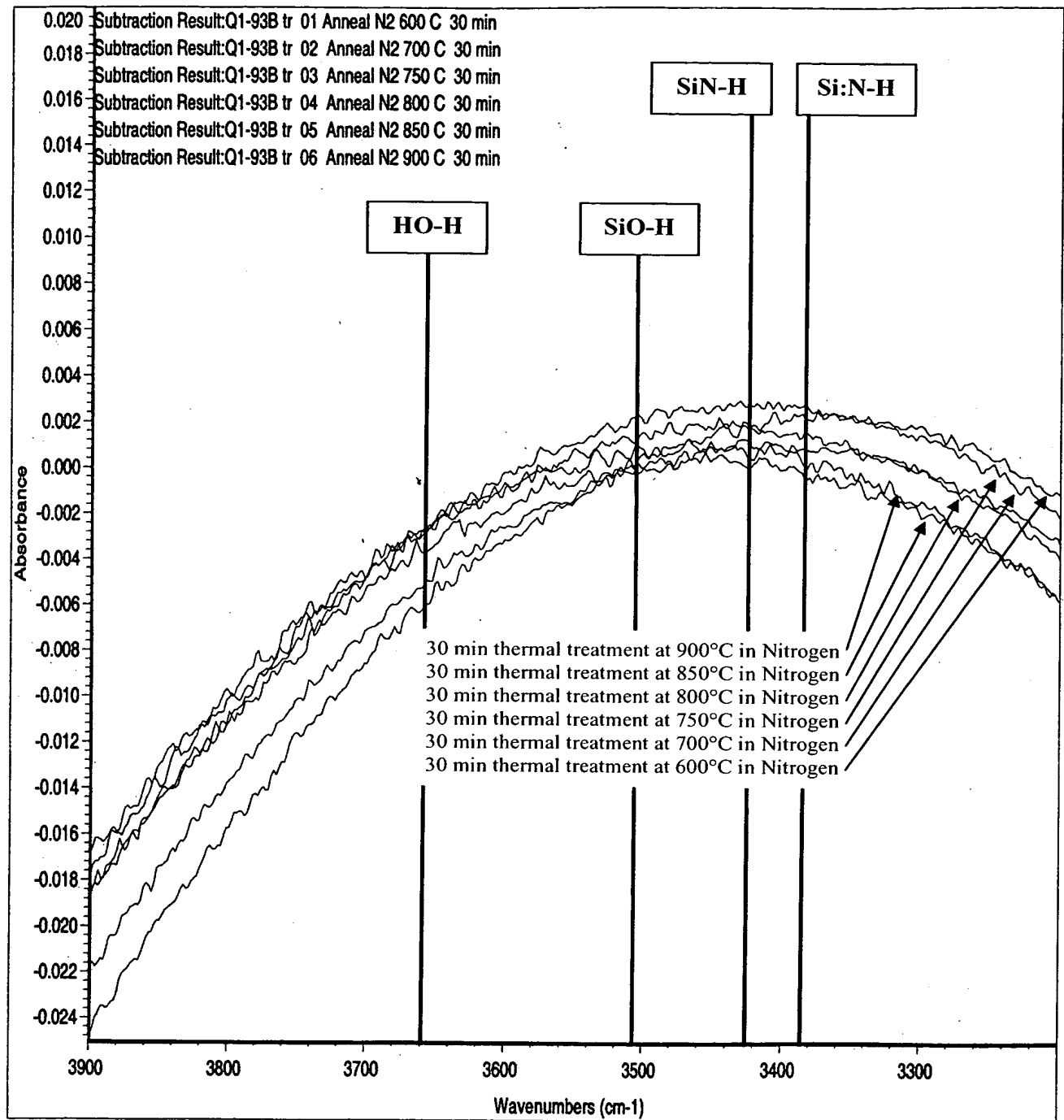


Figure 10

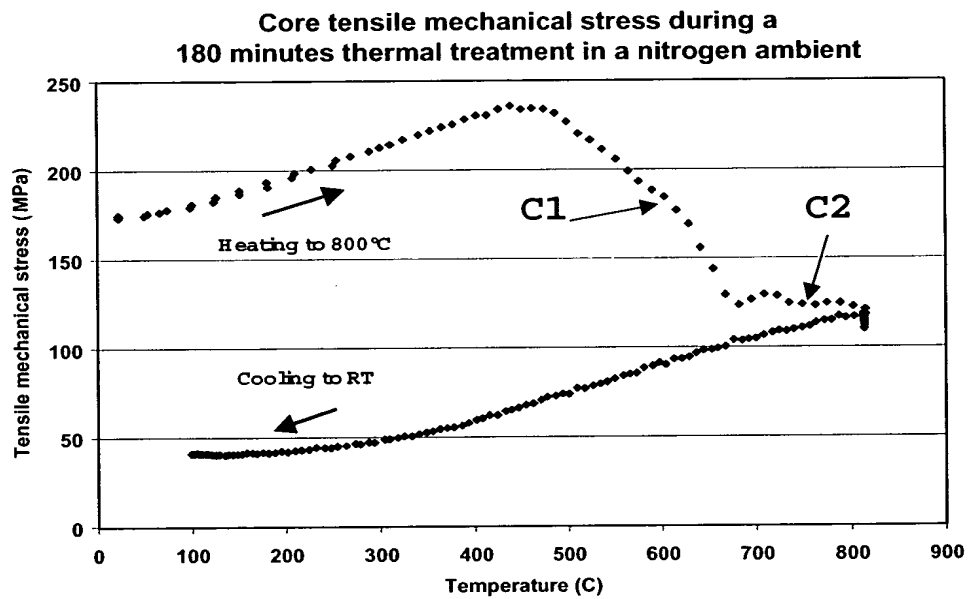
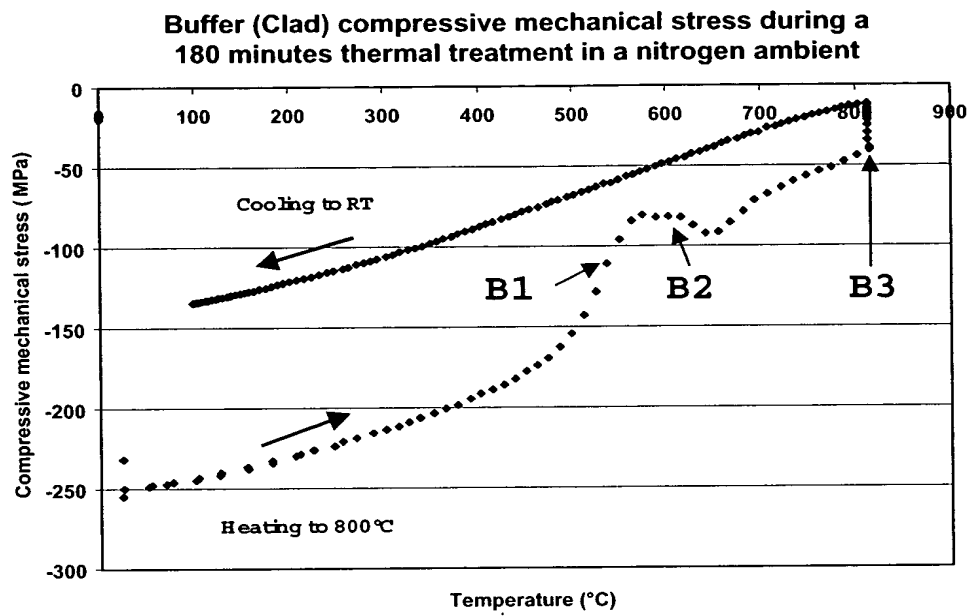


Figure 11

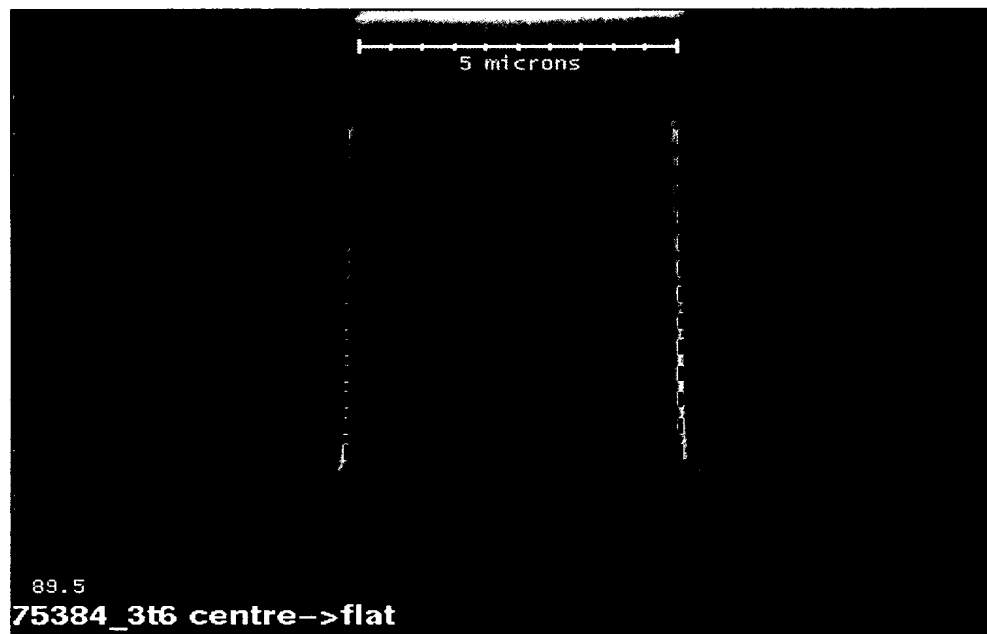
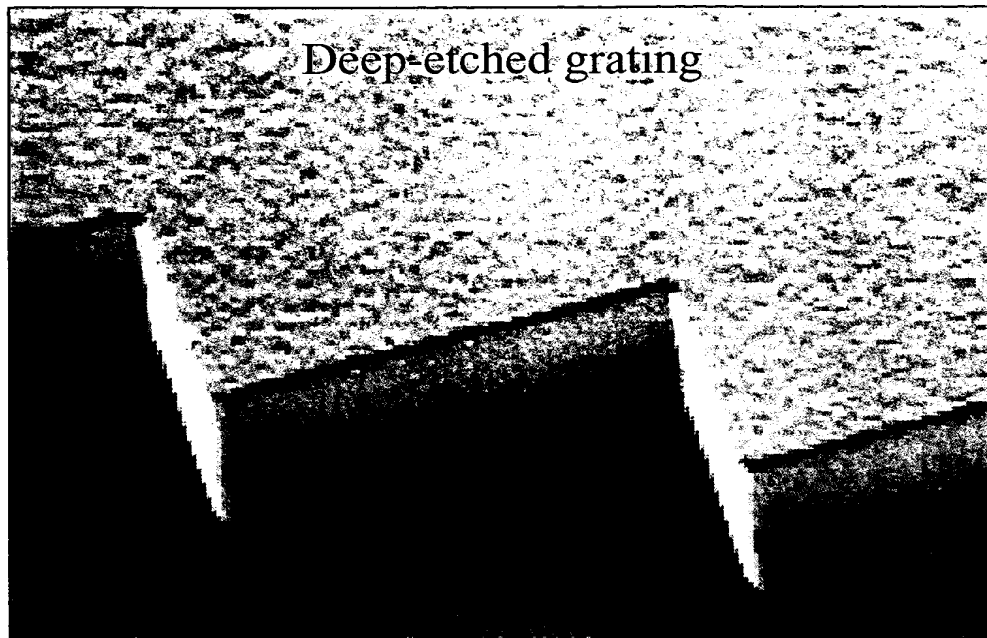


Figure 12

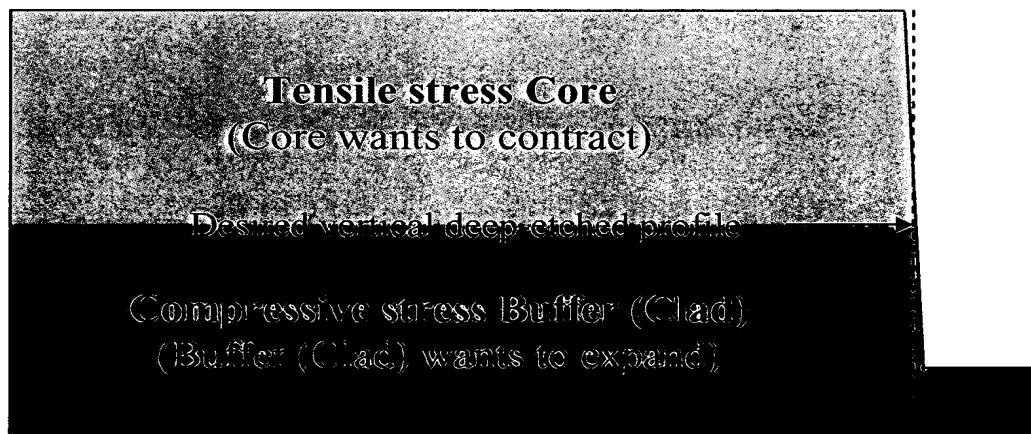
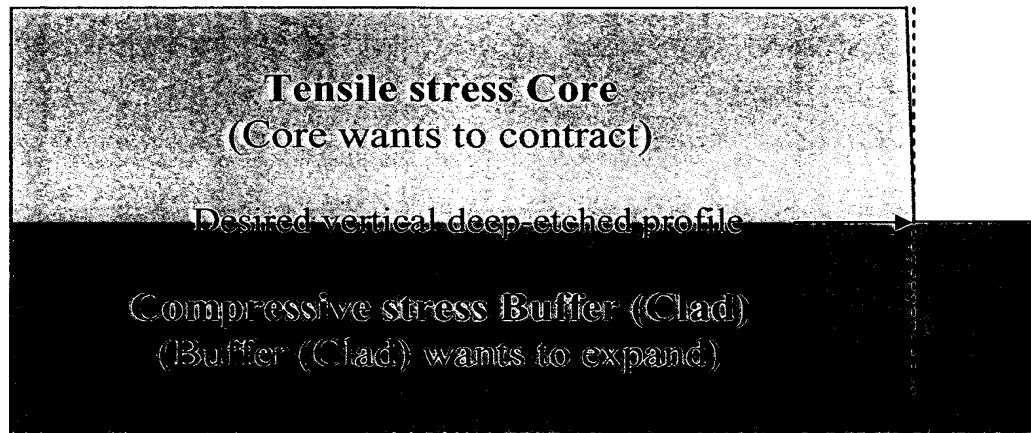
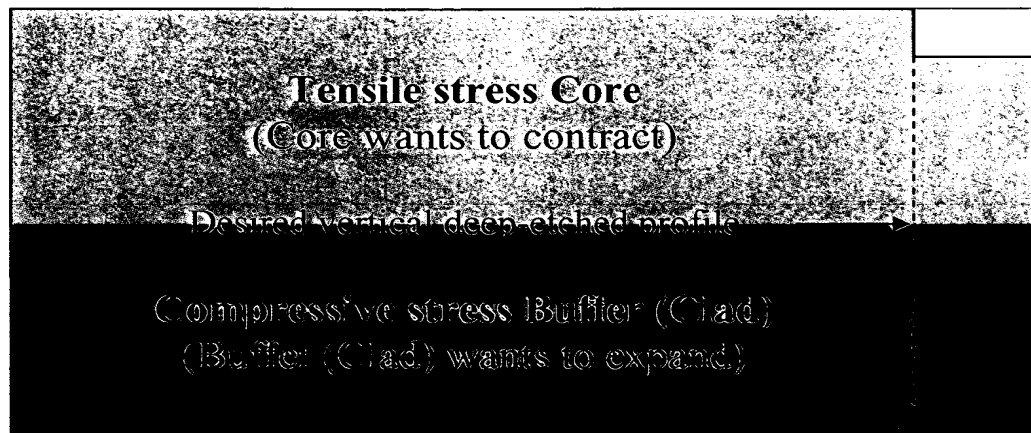
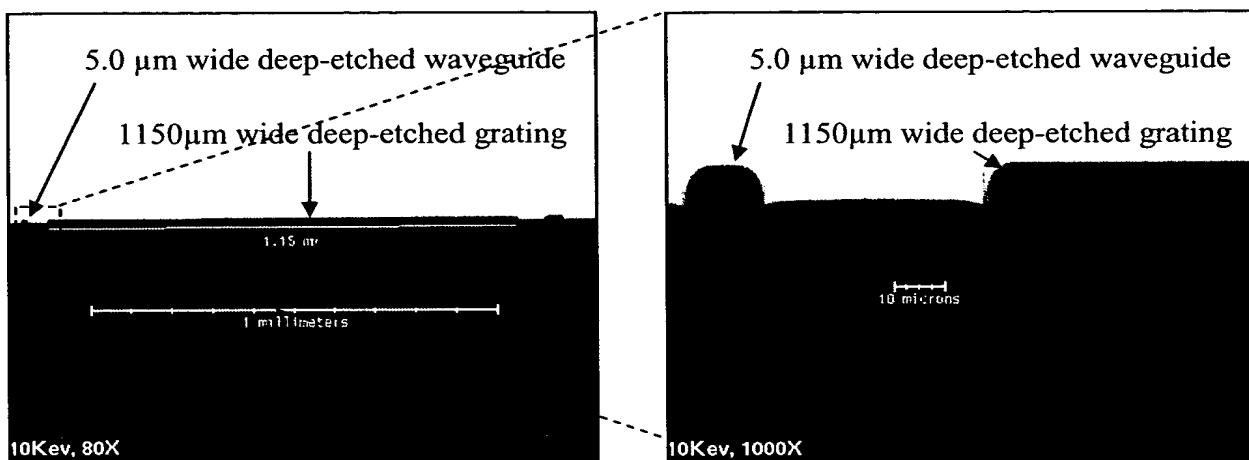
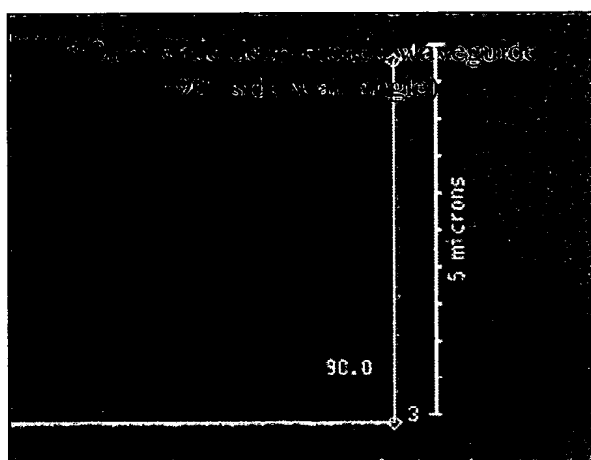


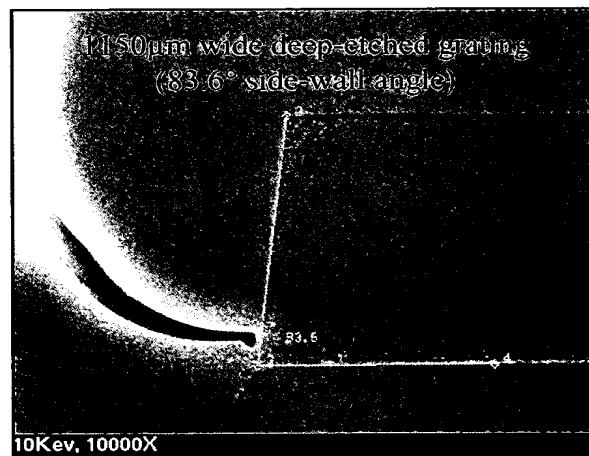
Figure 13



The relative position between an isolated 5.0 μm wide deep-etched waveguide and its neighboring 1150 μm wide deep-etched grating at two different magnifications.

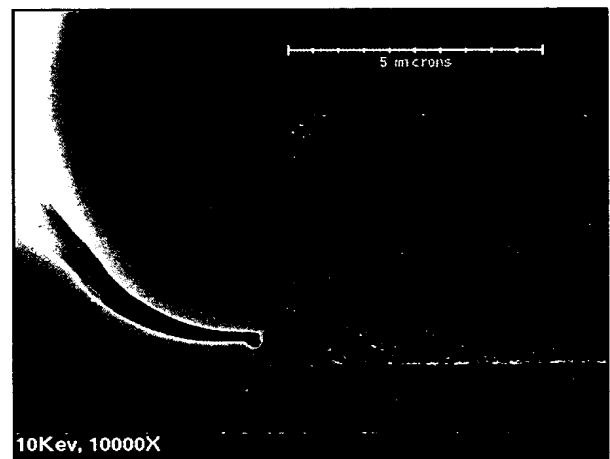
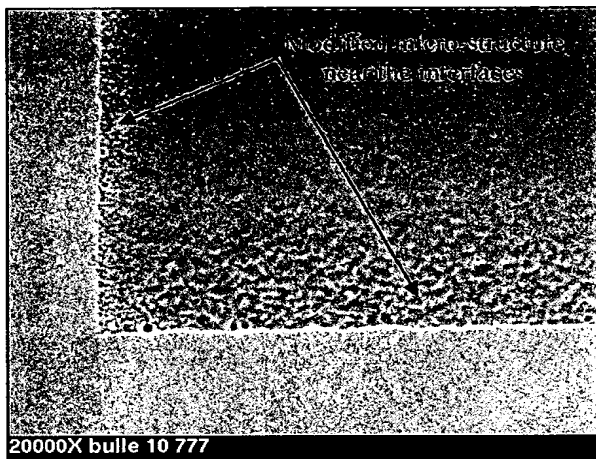
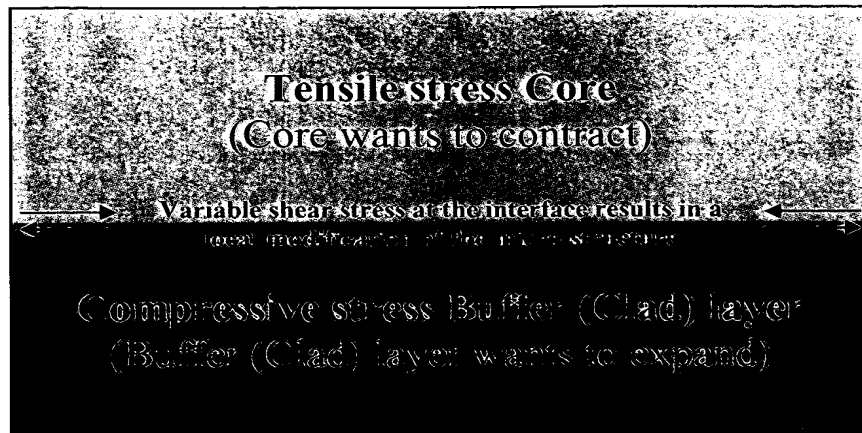


The side-wall of the 5.0 μm wide deep-etched waveguide facing the neighboring grating has a slope of about 90°.



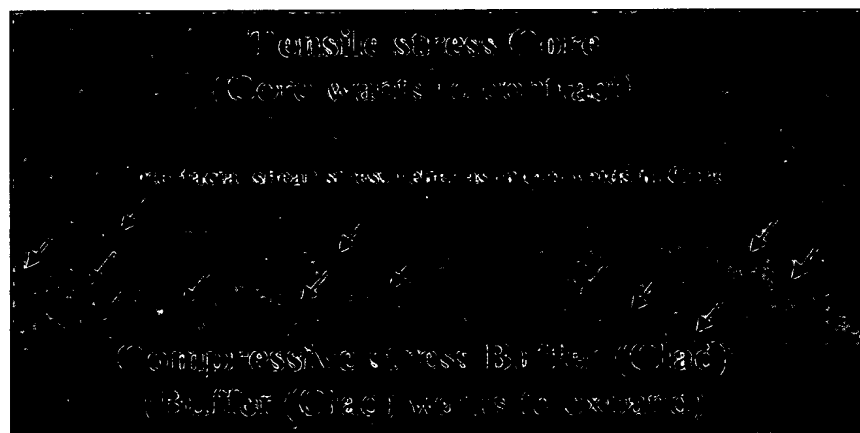
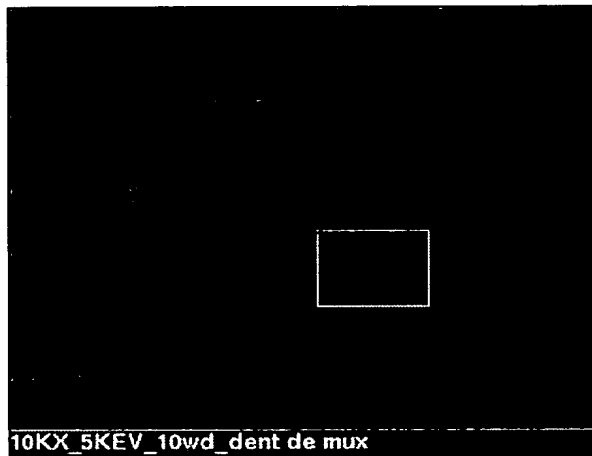
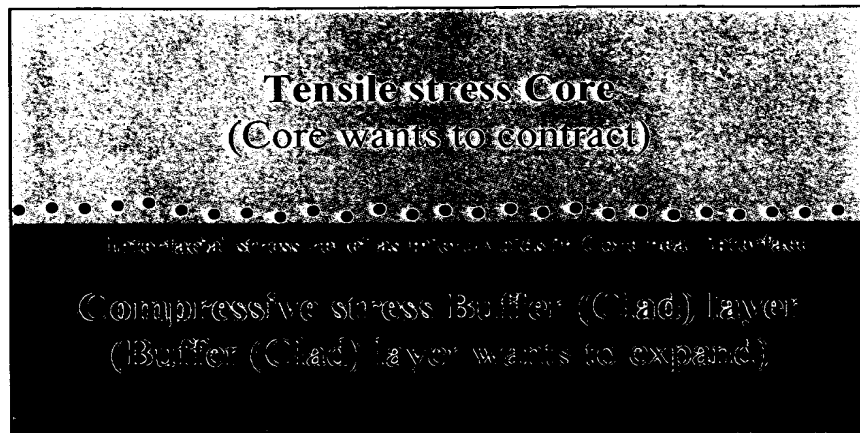
The side-wall of the 1150 μm wide deep-etched grating facing the neighboring deep-etched waveguide has a much smaller slope of about 84°.

Figure 14



20000X bullet 10 777

Figure 15



$\frac{d^2\phi}{dt^2} = -\frac{GM}{r^3}\vec{r}$

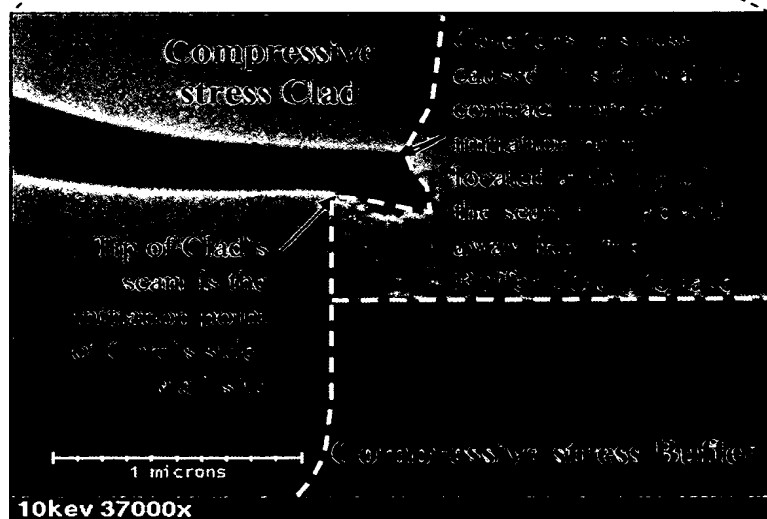
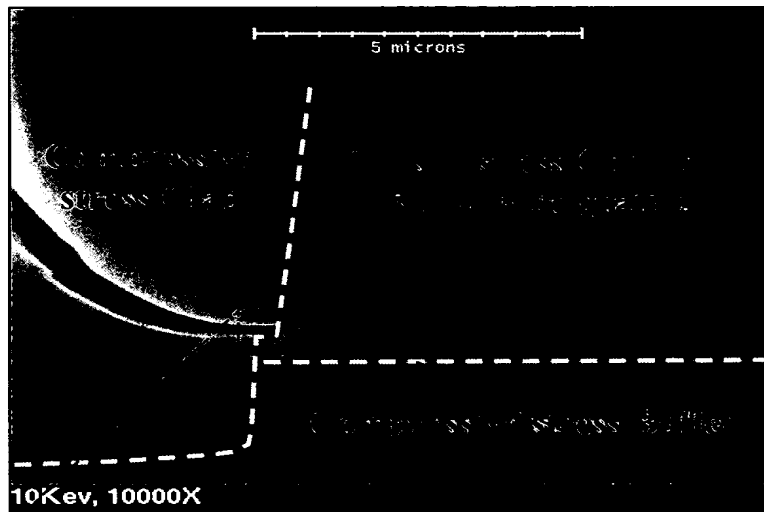


Figure 17

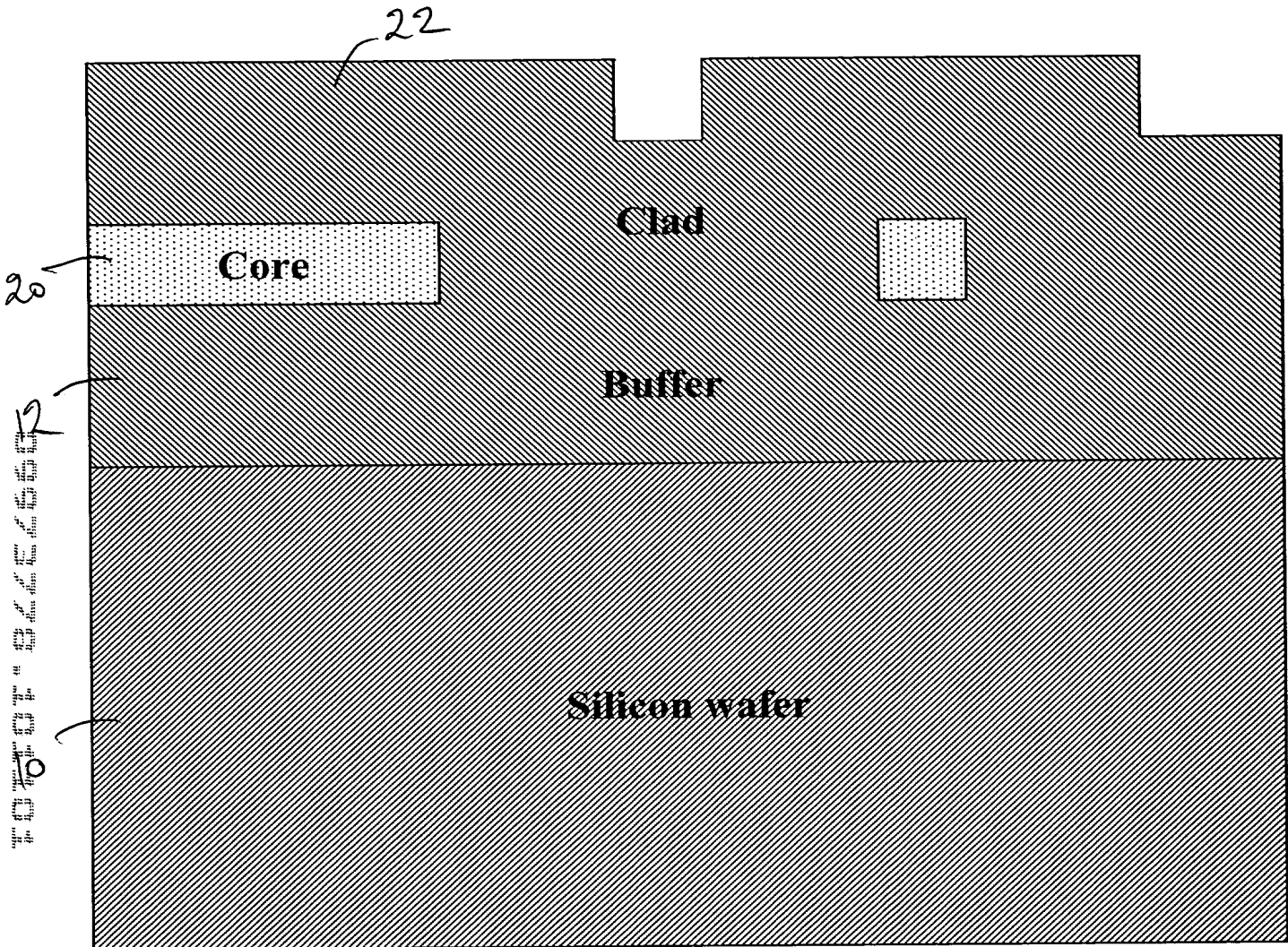


Figure 18a

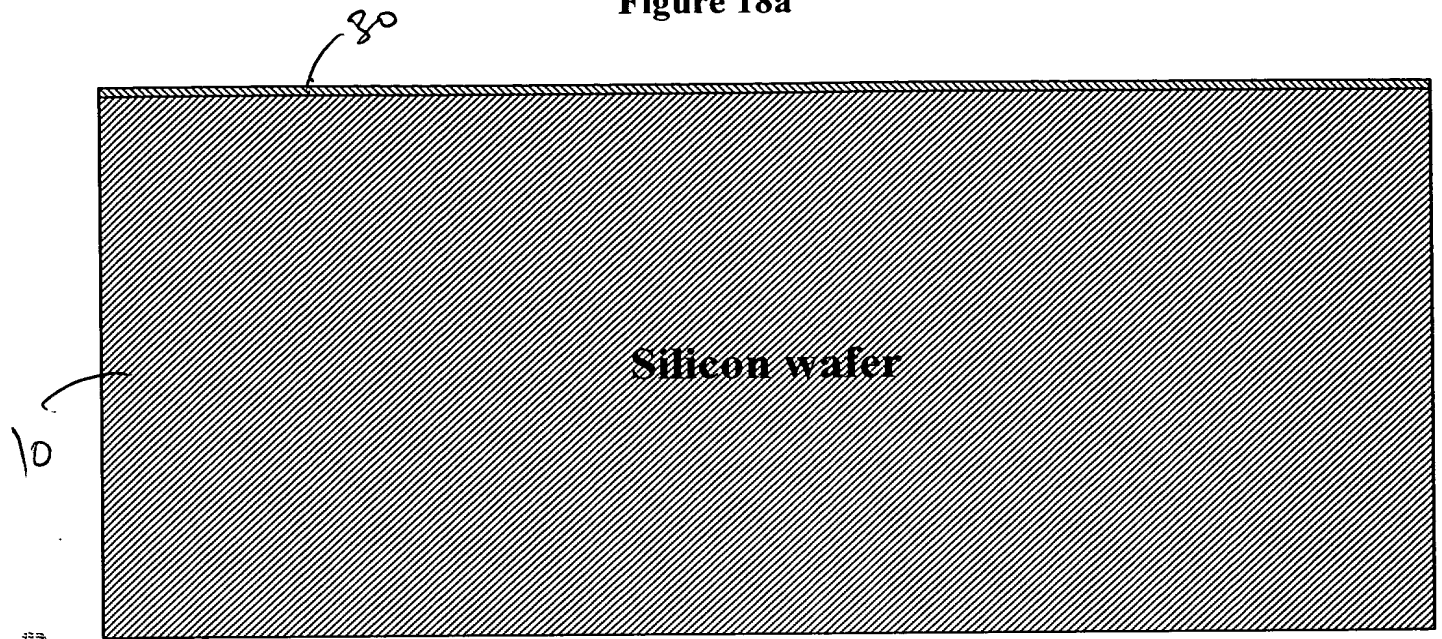


Figure 18b

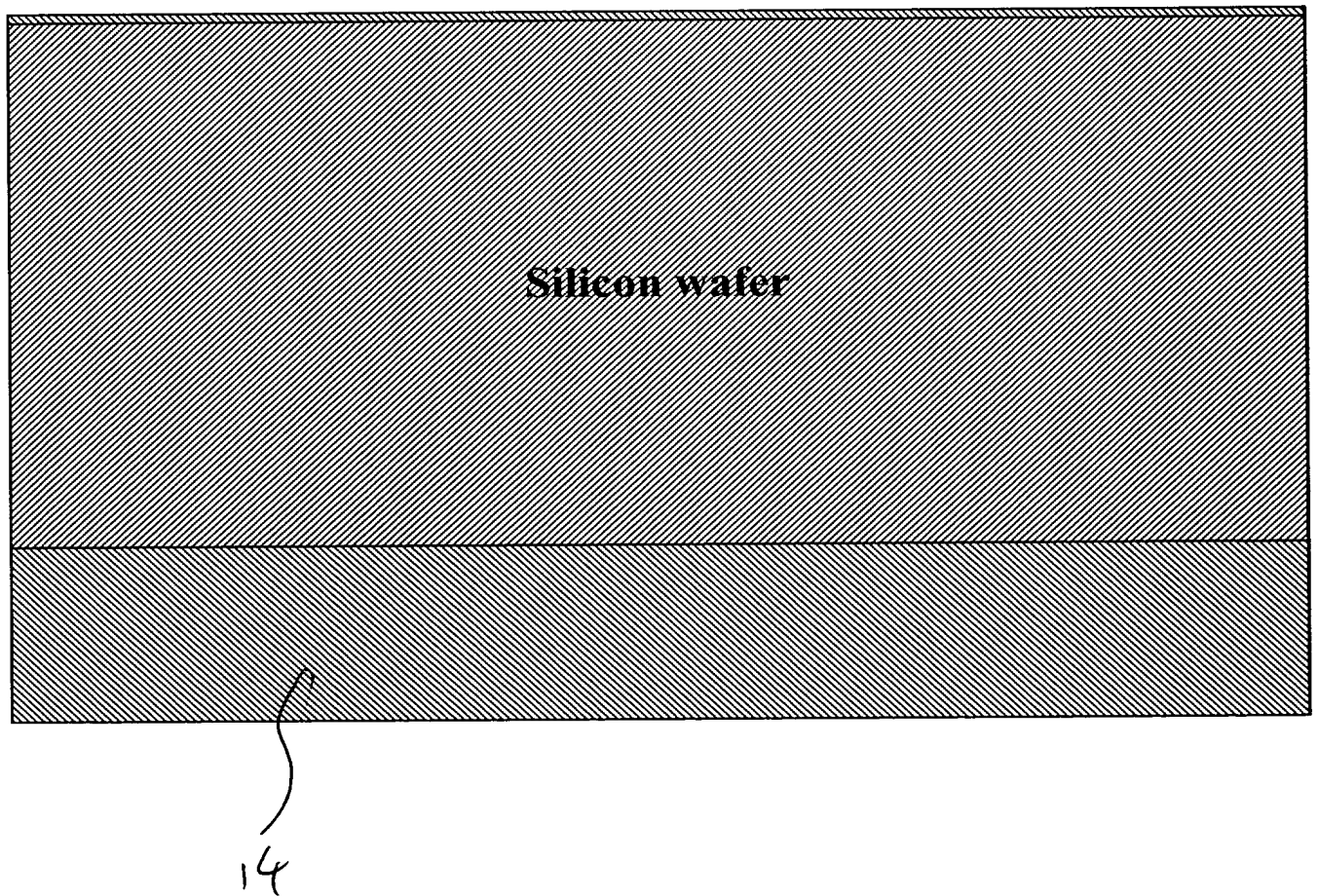
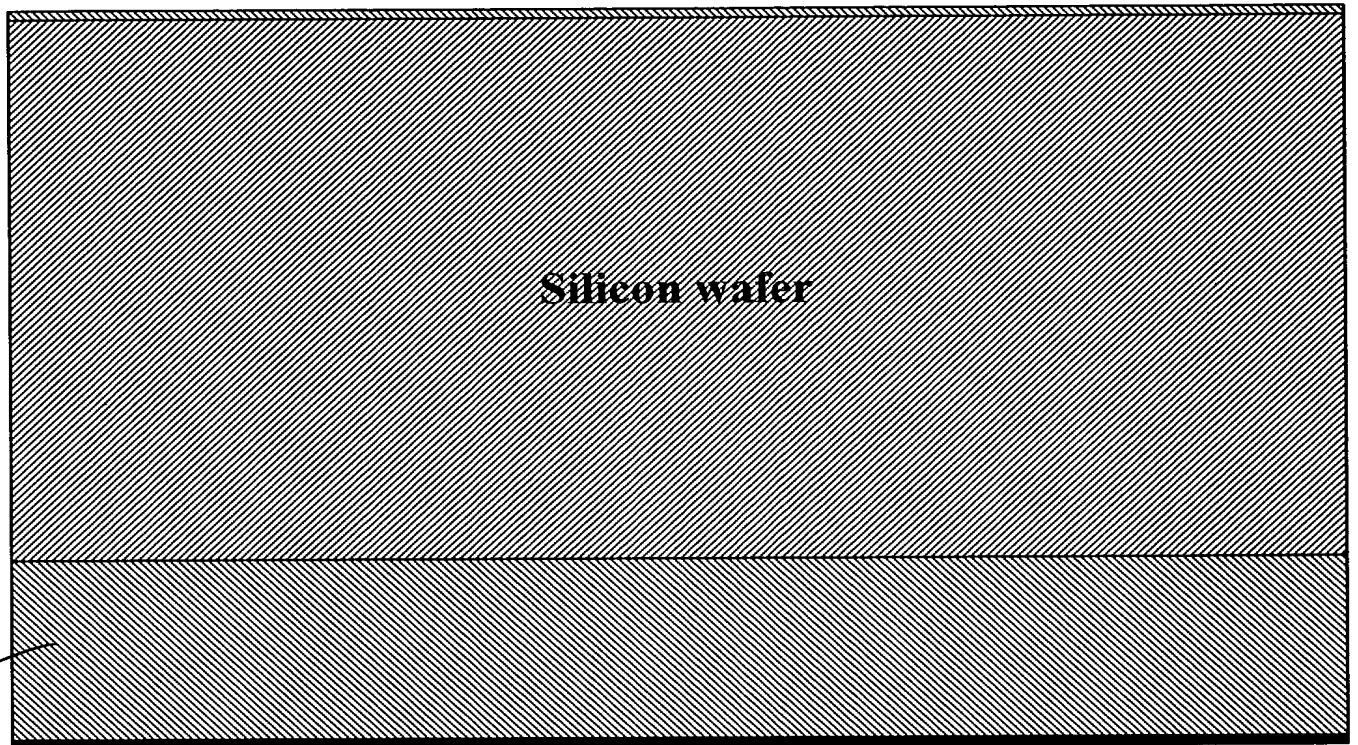


Figure 18c



32

Figure 18d

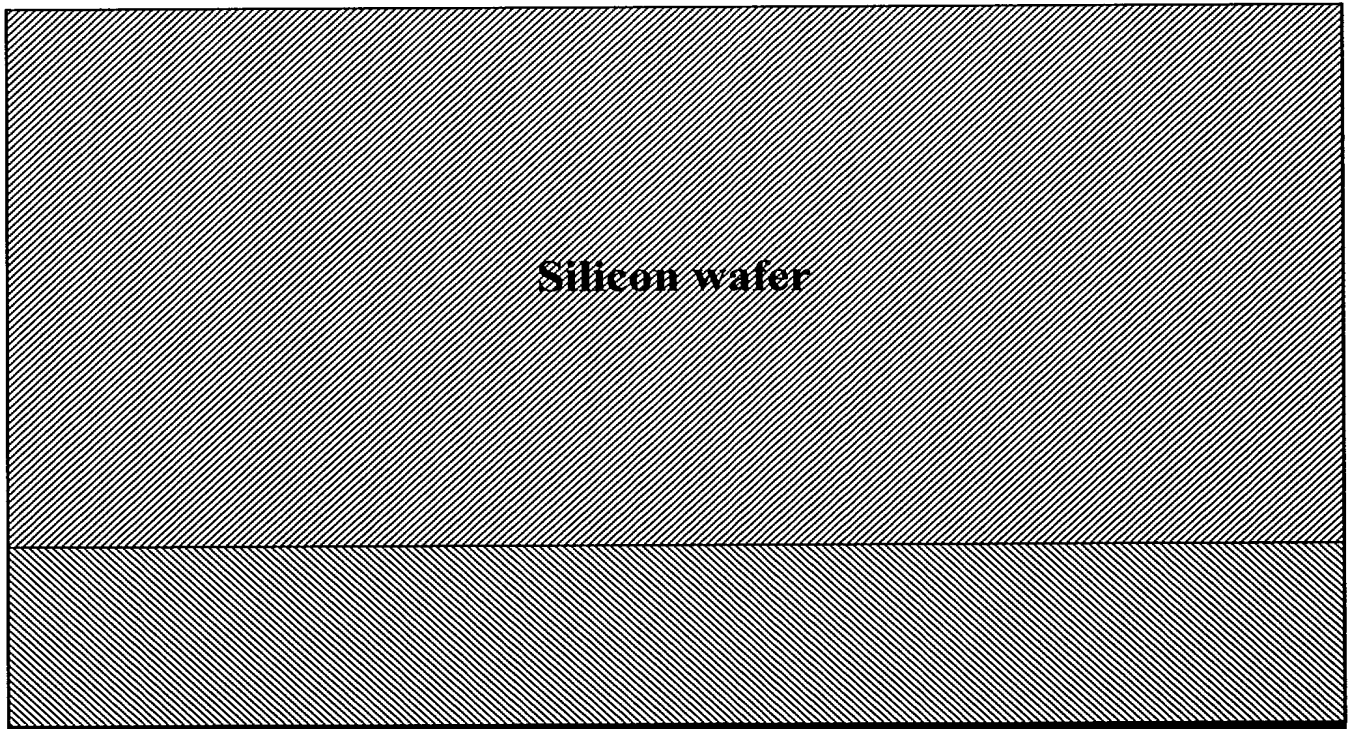


Figure 18e

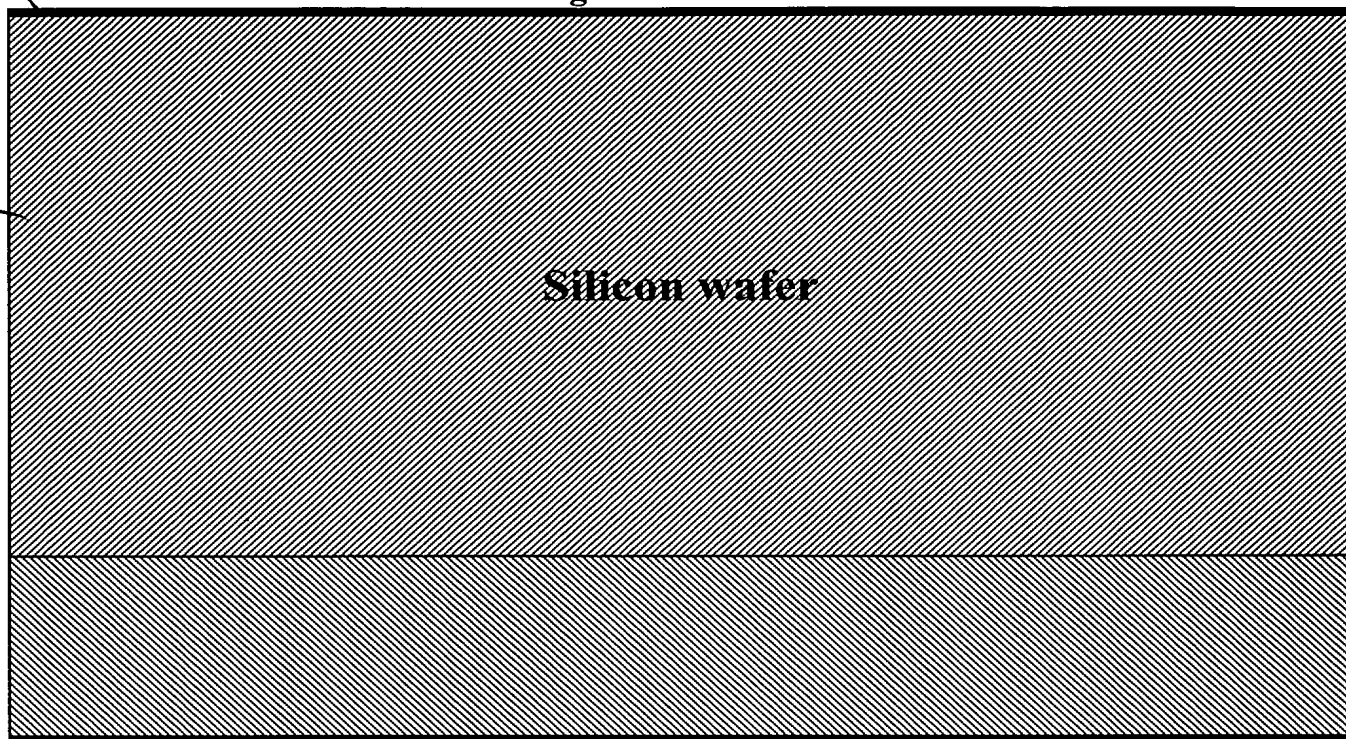
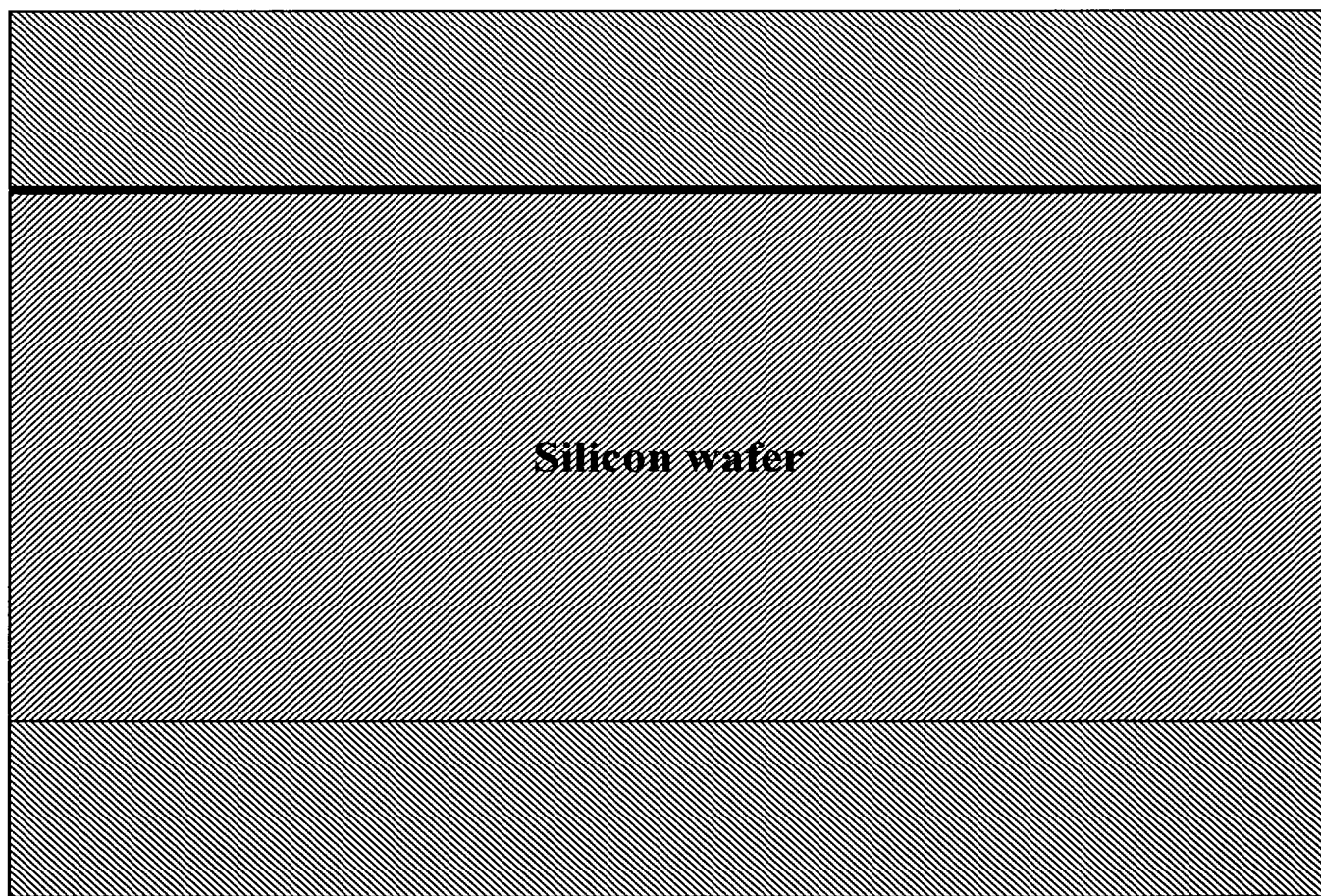


Figure 18f



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Figure 18g

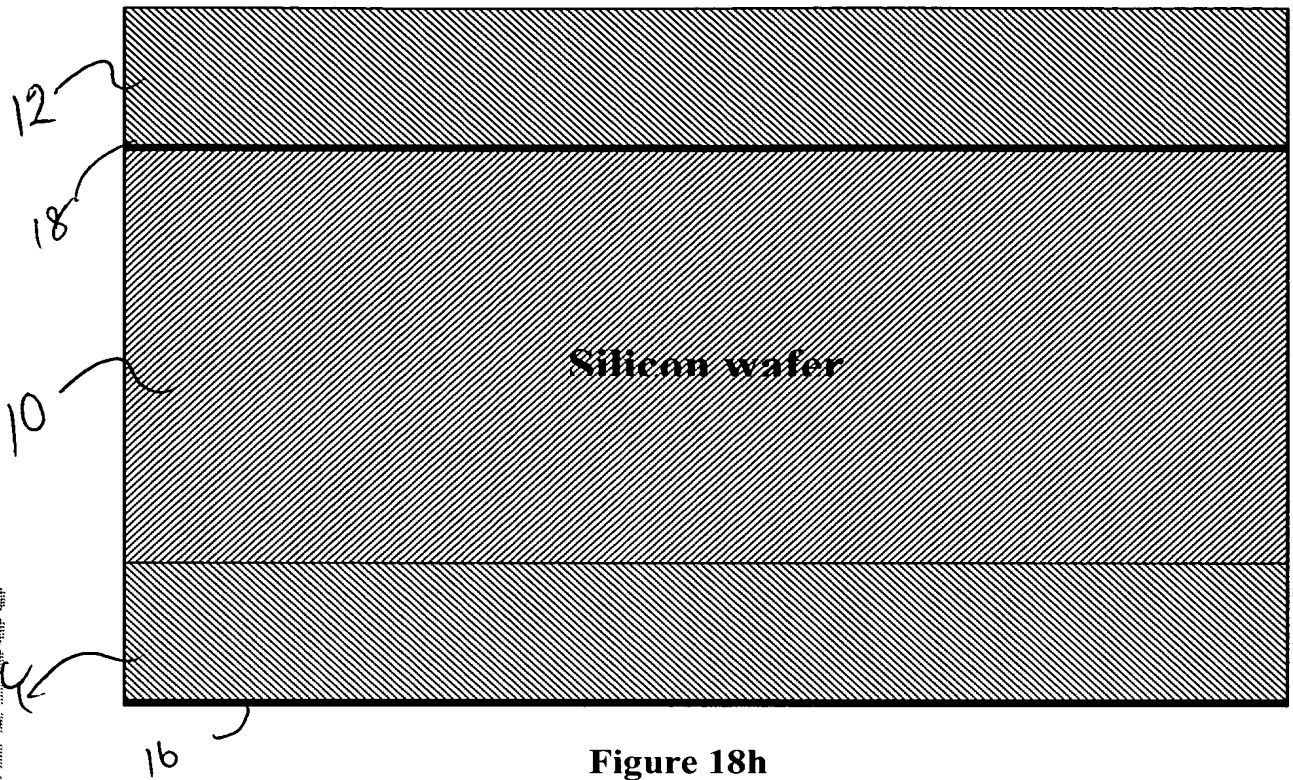


Figure 18h

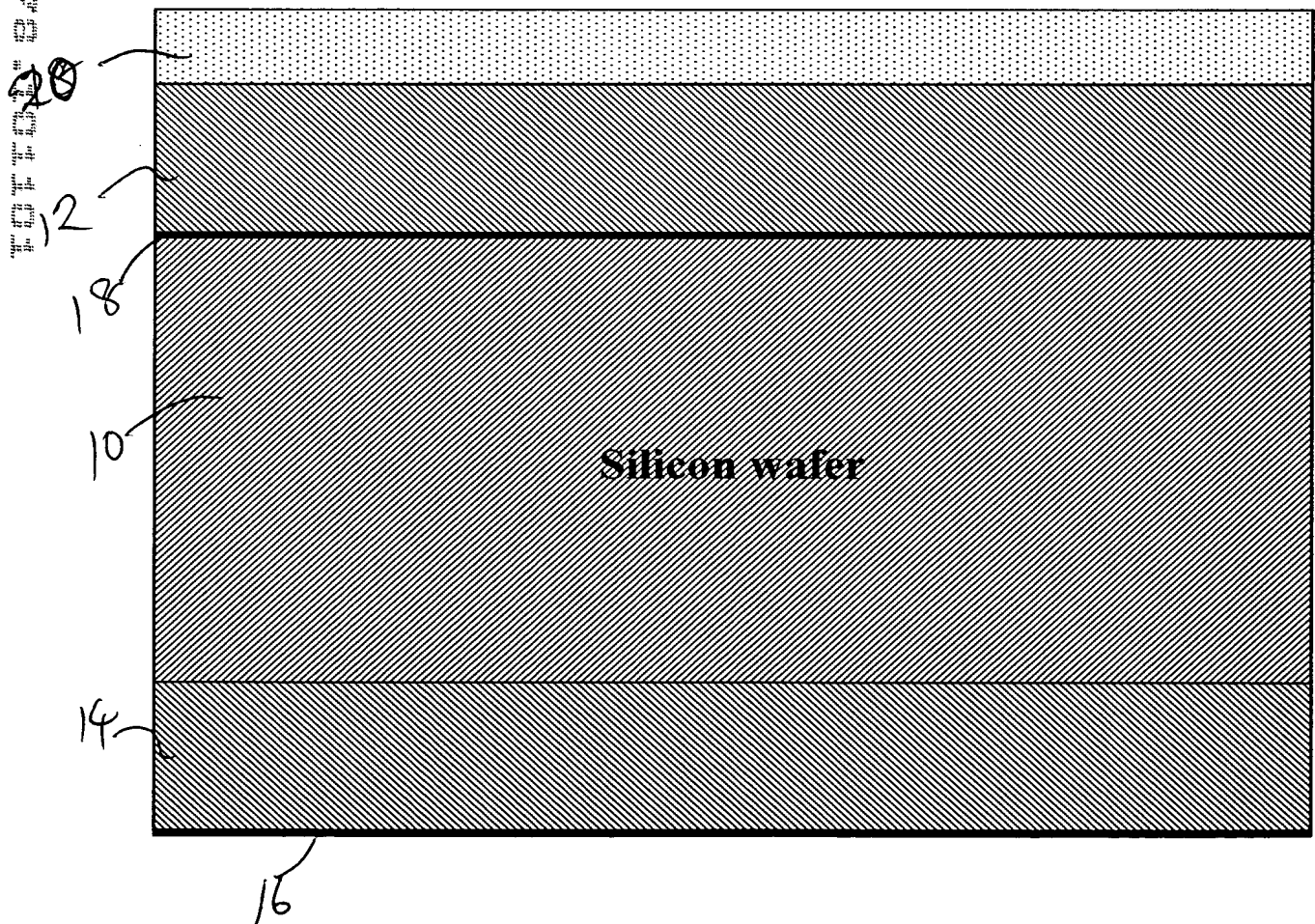


Figure 18i

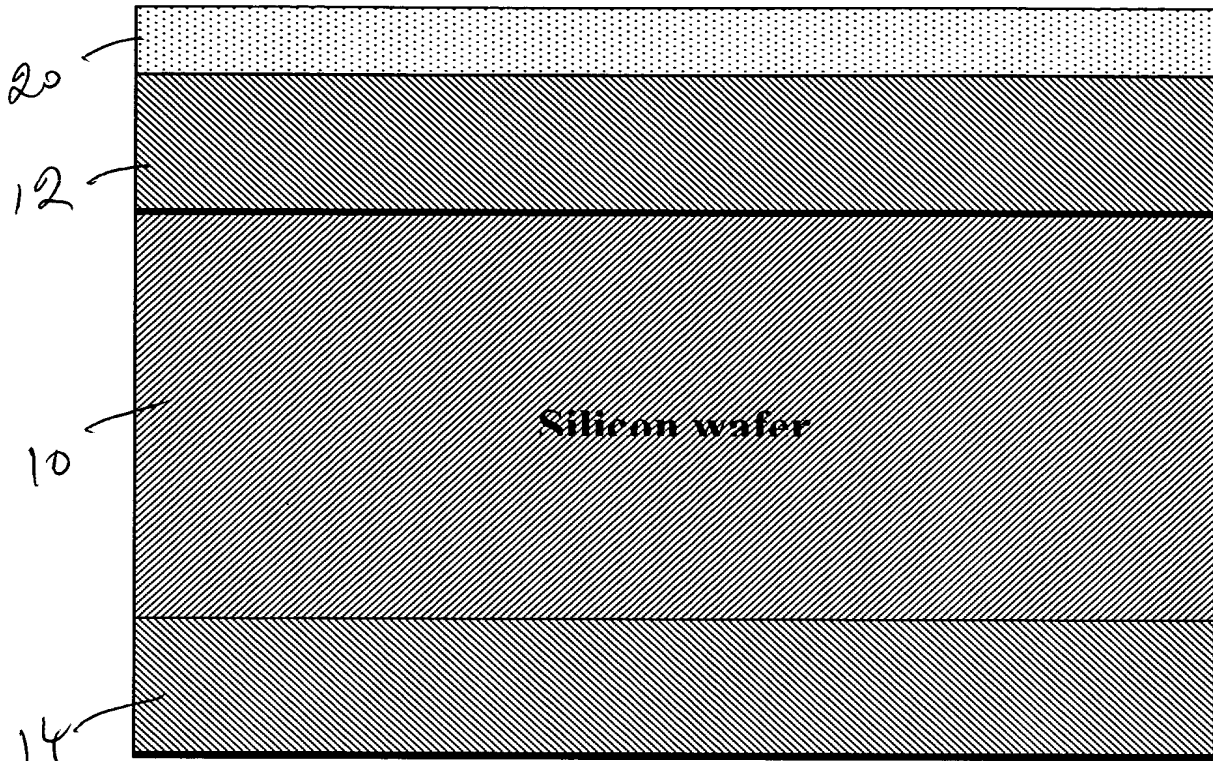


Figure 18j

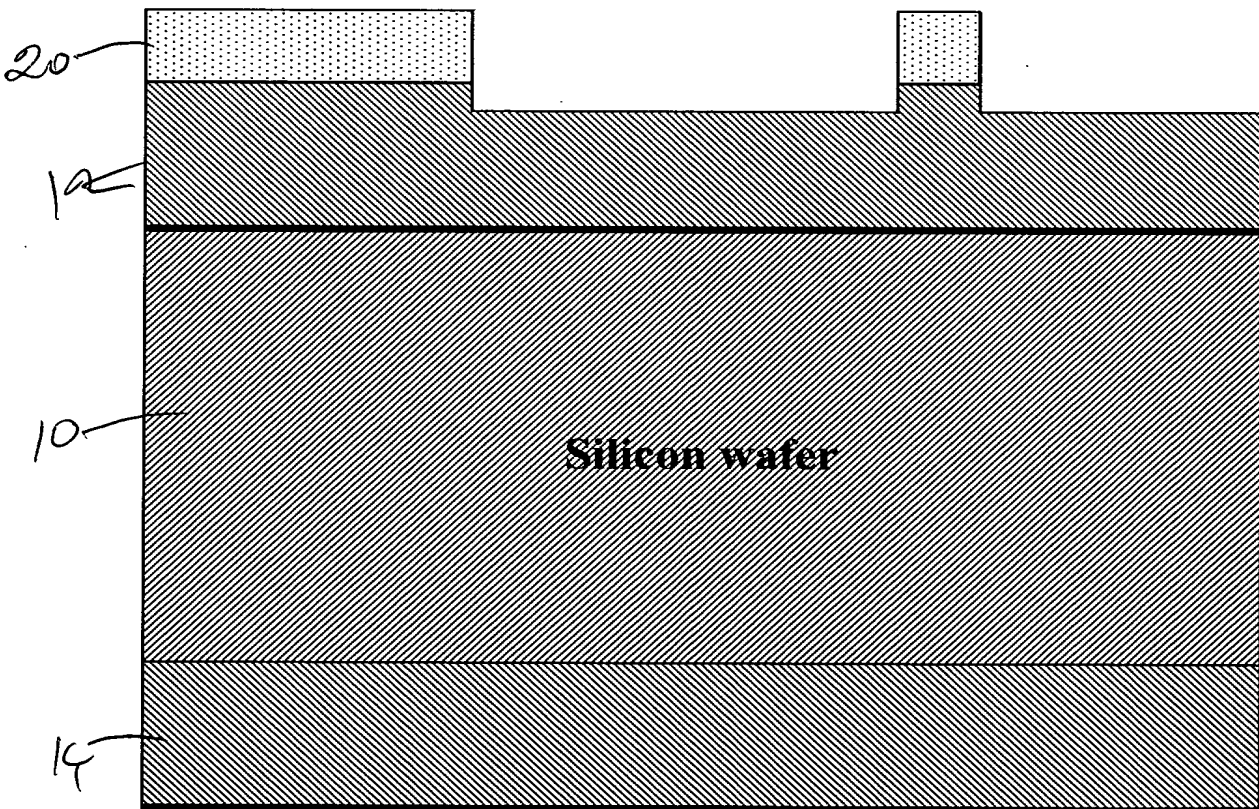


Figure 18k

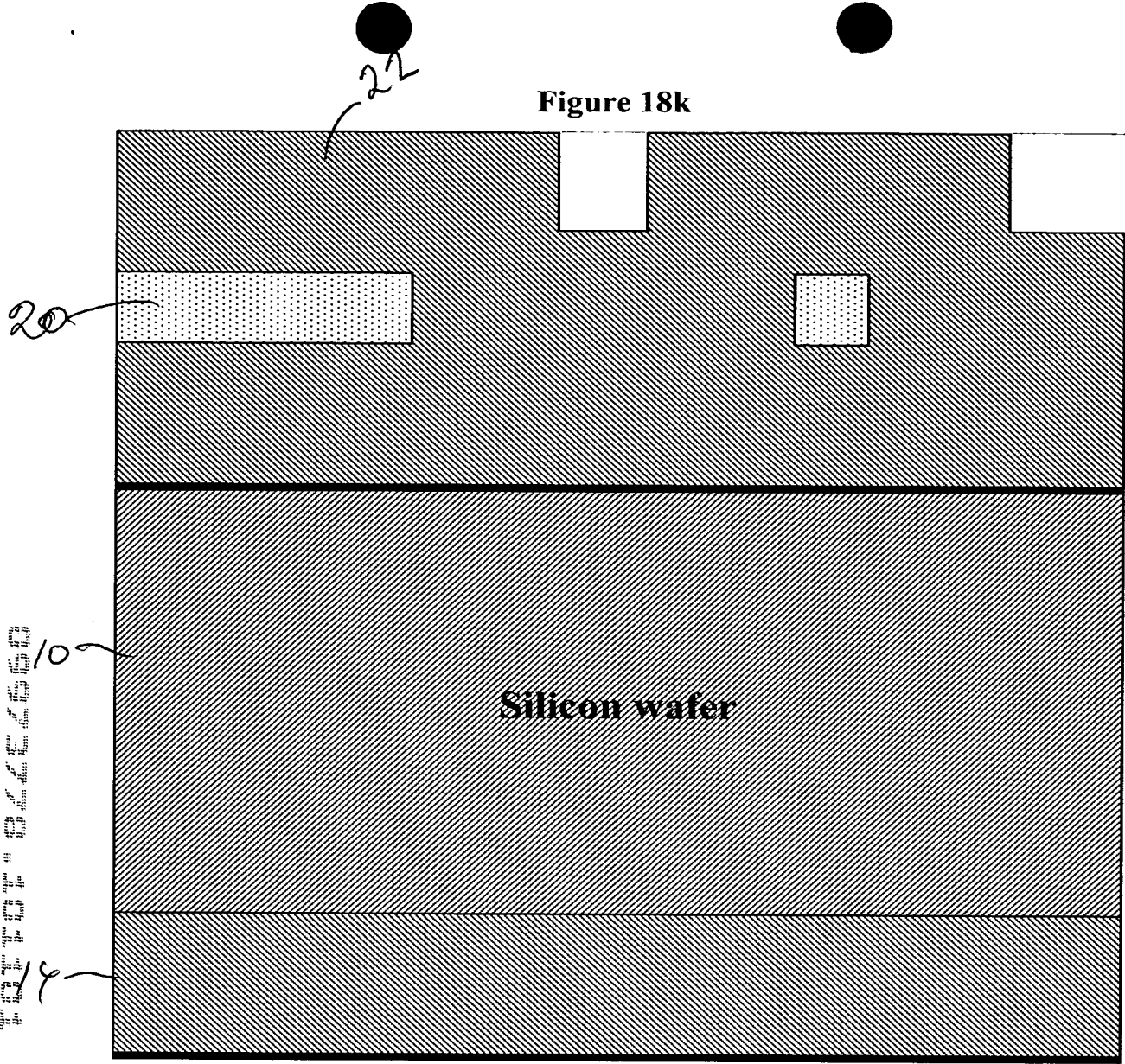


Figure 18l

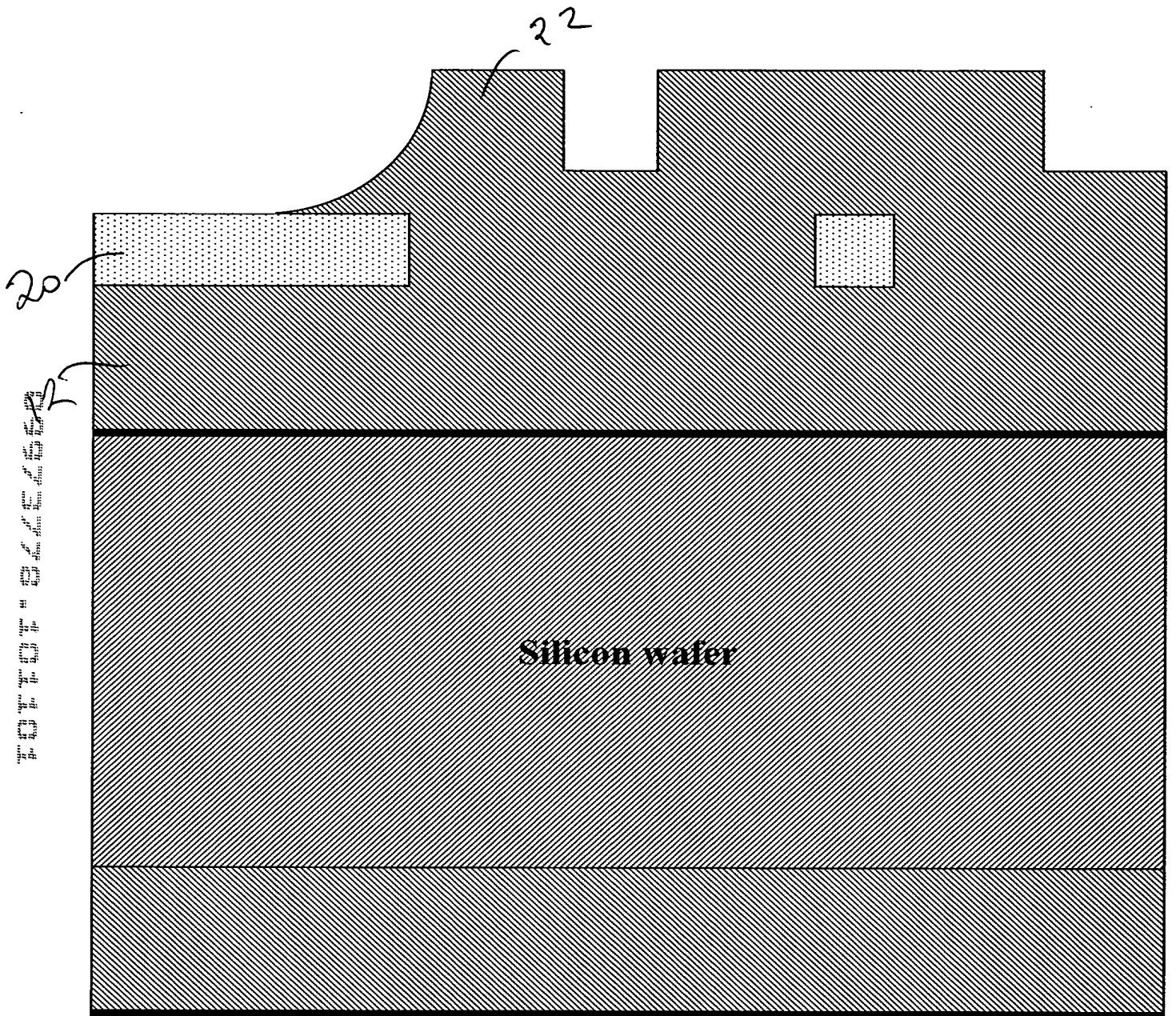


Figure 19

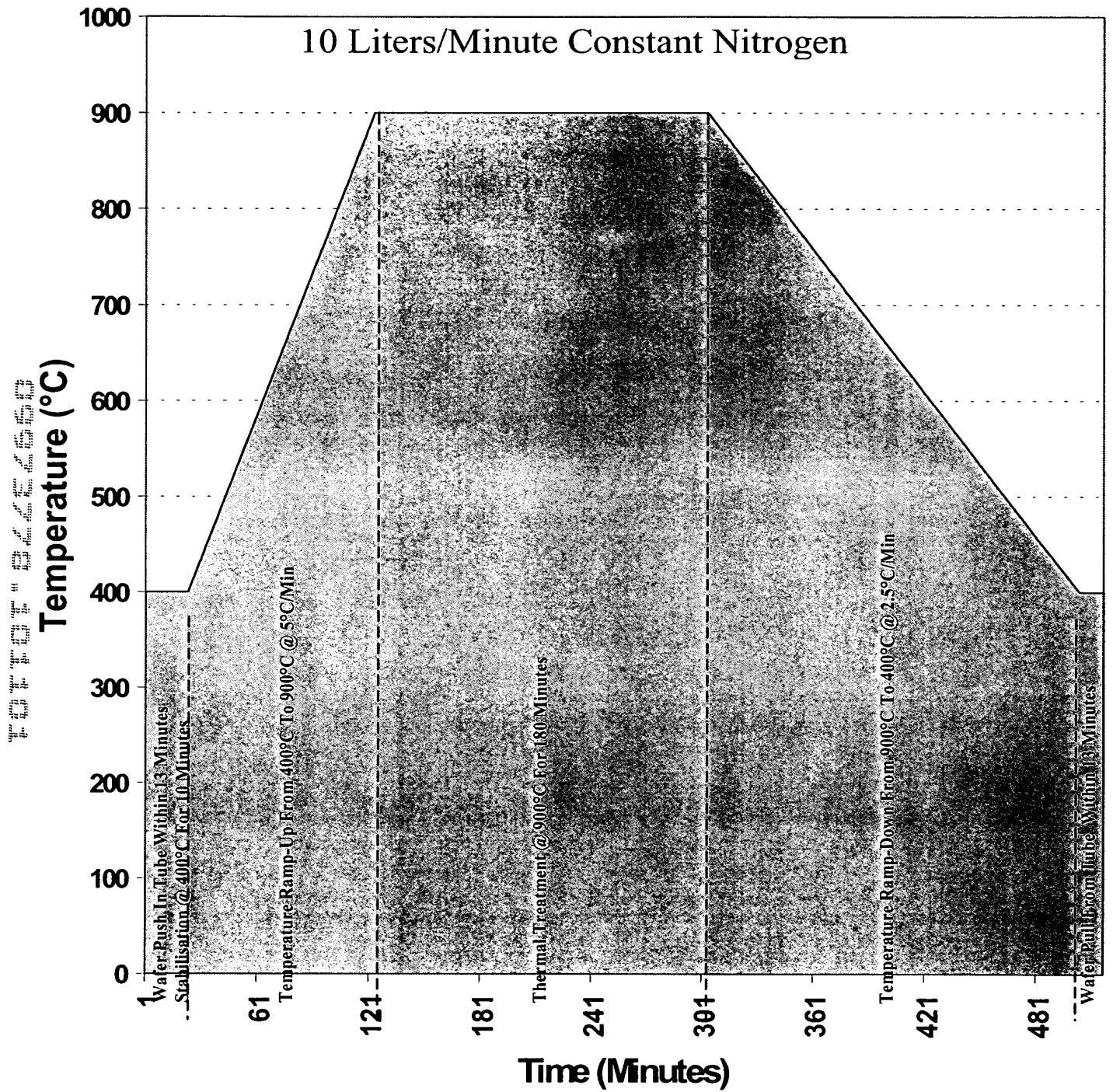


Figure 20

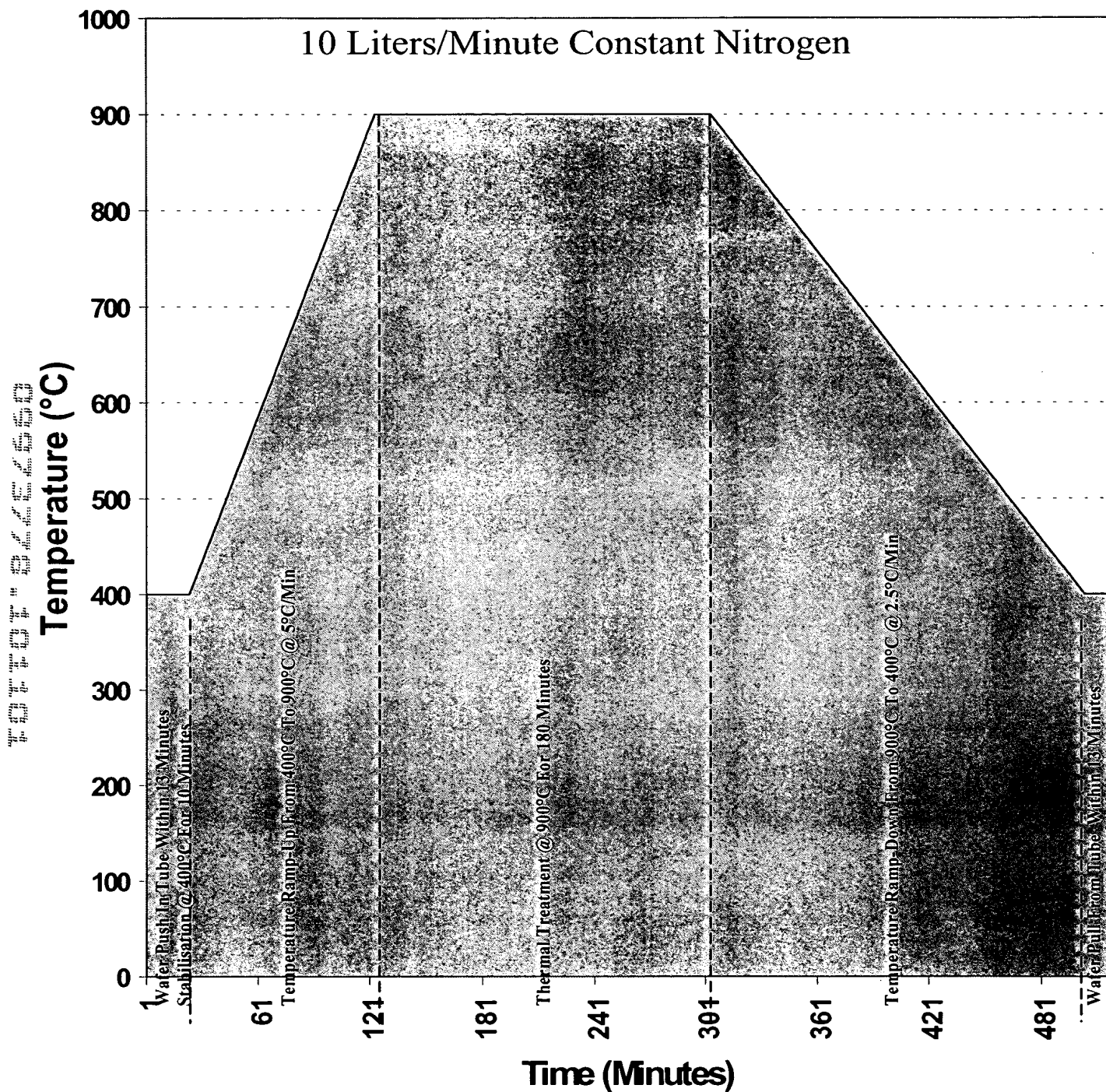


Figure 21

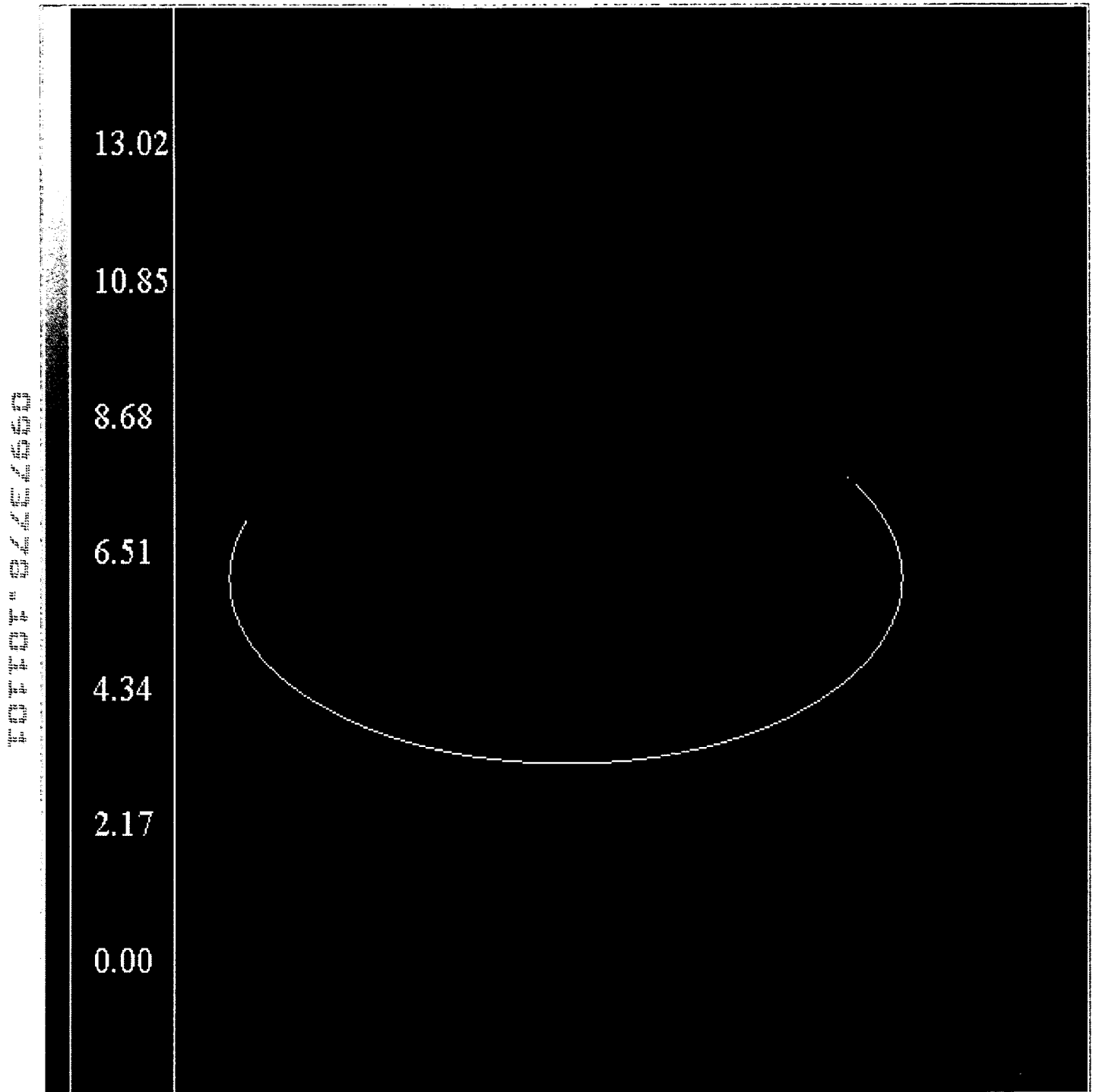


Figure 22

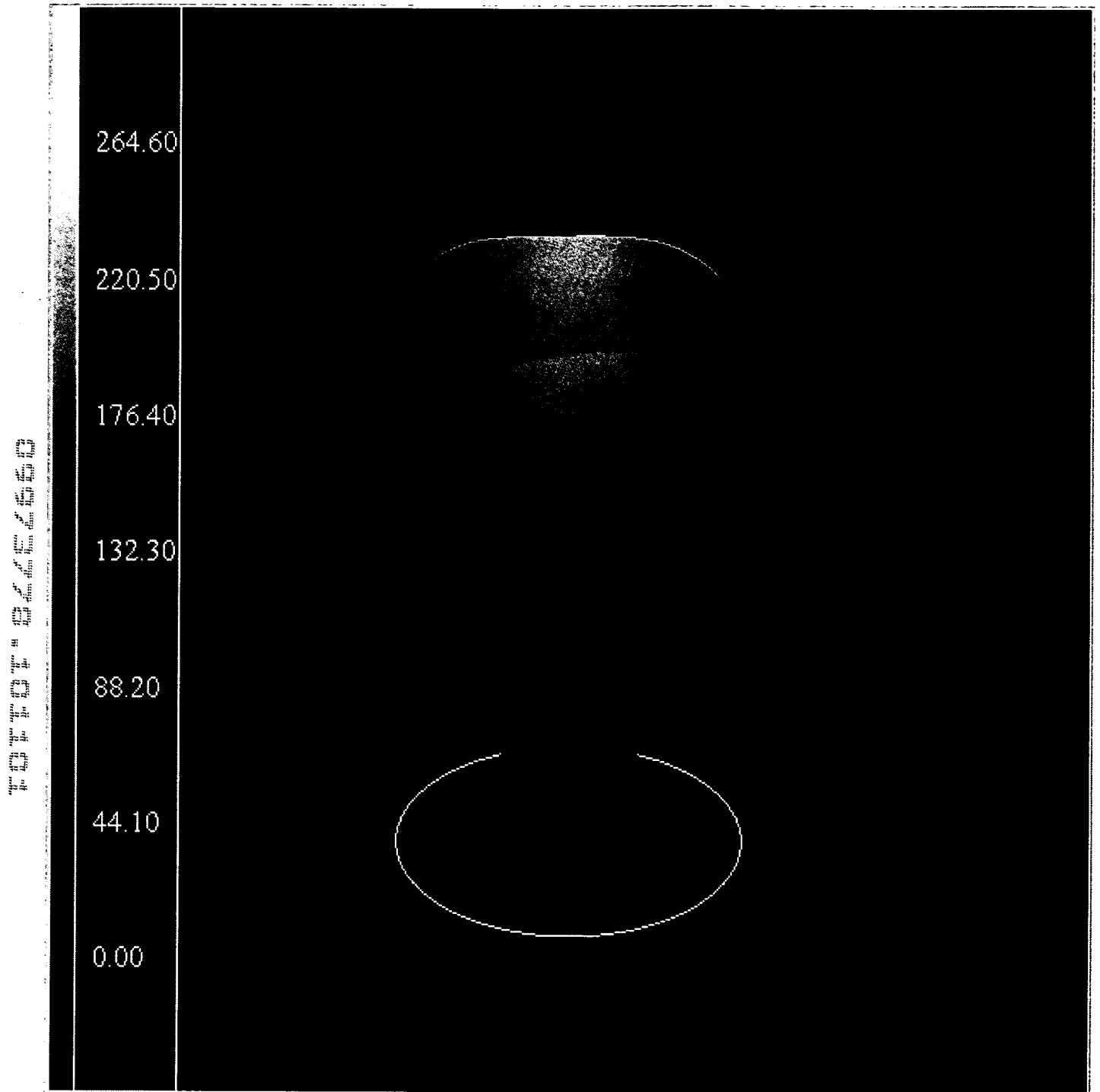


Figure 23

